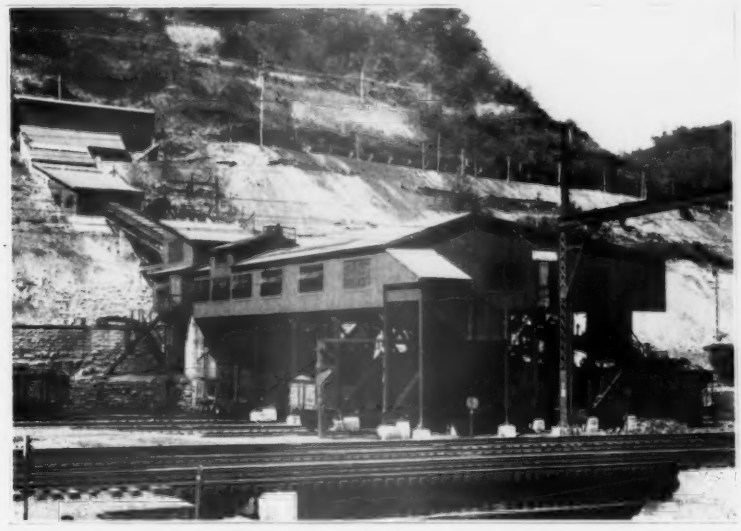
The MINING CONGRESS JOURNAL

Volume 12 JULY, 1926 No. 7

R AND S COMPANY WRIGLEY BLDG CHICAGO



Marcus Tipple built for the Upland Coal & Coke Co. at Elkhorn, W. Va. Capacity, 2,000 tons per day. Loading Lump, Egg, Nut, Pea, Slack and picked Mine Run on 5 tracks.

R AND S COMPANY WRIGLEY BLDG CHICAGO

The solving of one bituminous operator's problem

The problem that is common to the bituminous end of the coal business:

To produce for a market, that, because of the steadily increasing production of bituminous coal, is yearly becoming more and more particular, a coal that will lead against competition not only because of its natural quality but because of an unusual preparation.

At the Upland mine, the breakage that occurs during the preparation of the coal is cut to the smallest possible amount. What degradation there is is taken out as the coal is carefully loaded in the car. As a result, although the coal is a No. 3 Pocahontas, the Upland mine ships a greater percentage of the large sizes with less fine coal to the car than is generally thought possible.

Also, by virtue of some thoughtful designing, there is very little coal wasted with bone that is sent to the refuse pile.

How it was done we shall be very glad to tell anyone who is interested. Bulletin No. 83 (on the presses) gives the details of the equipment and will be sent on request.

That Upland was built after two other mines, erected for the same company, had proved their efficiency bears witness to the soundness of our ideas in designing and the skill used in construction.

418 Oliver Building
Pittsburgh, Pa.

ROBERTS AND SCHAEFER CO.
ENGINEERS AND CONTRACTORS
CHICAGO, U.S.A.

527 First St., Box 570
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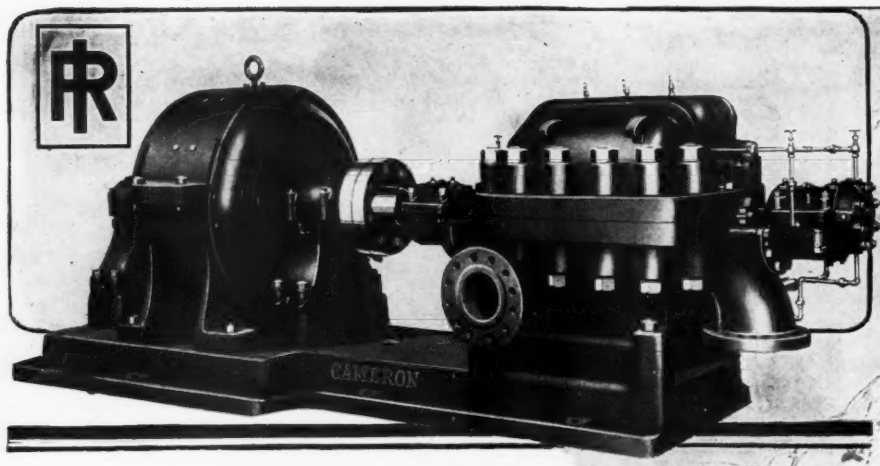
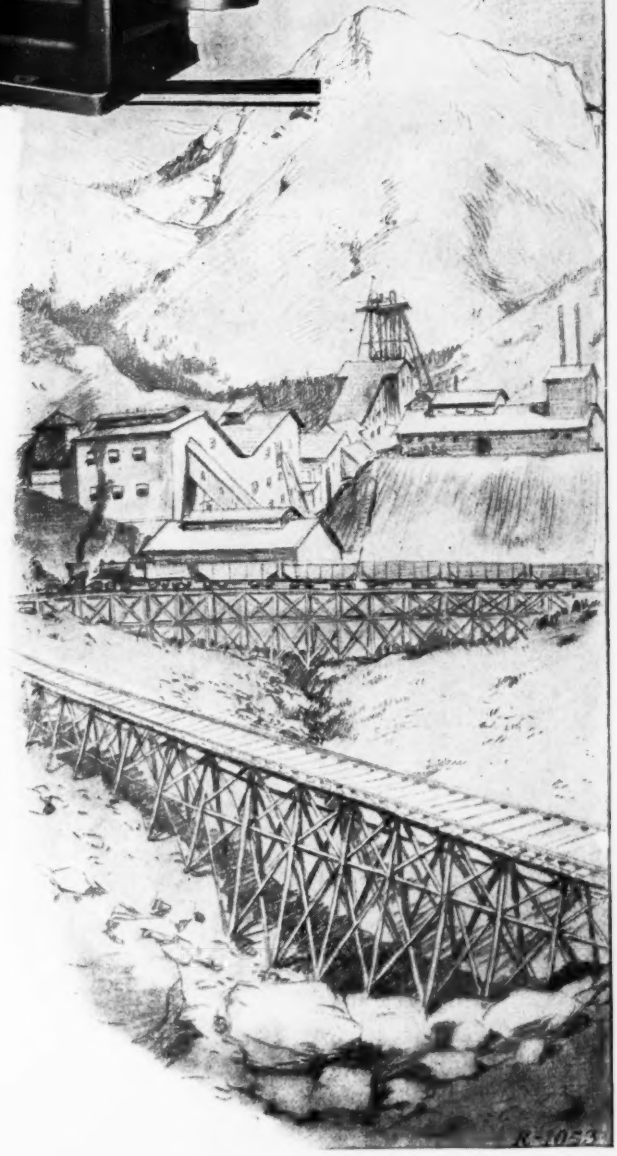


Mine Pumps

Cameron Pumps have proved their superiority in the handling of acid-laden mine water.

Ofttimes isolated from the engine room and unattended except for an occasional oiling, they run on indefinitely—doing their jobs as only superior pumps can.

Ingersoll-Rand Company's vast experience with mining conditions, together with Cameron's experience in pump design, makes possible the building of mine pumps exceptional in their durability, economy, and low upkeep cost.



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POINTS OF MARKED SUPERIORITY IN HERCULES DETONATORS

Hercules Electric Blasting Caps are shorter and larger in diameter than most others. This permits of better construction of the electrical elements. It also enables us to produce better water-resisting qualities in our electric caps than are found in electric caps of other manufacture. The shorter cap is less likely to go through the cartridge and detonate from impact with the sides of the bore hole.

Bridge wires are made of platinum-iridium, and broken bridges in our electric caps are practically unknown.

Both Hercules Blasting Caps and Hercules Electric Blasting Caps are charged with a fulminate-chlorate mixture. This is more expensive than the compounds used by some others, and it is more effective, more certain, and will stand up better than the cheaper compositions under the varied conditions met in the field.

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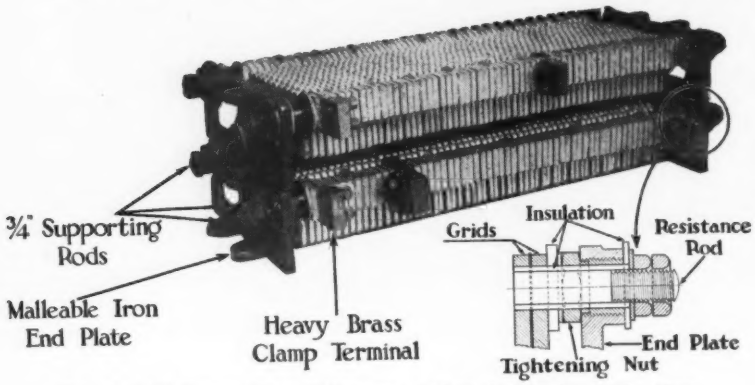
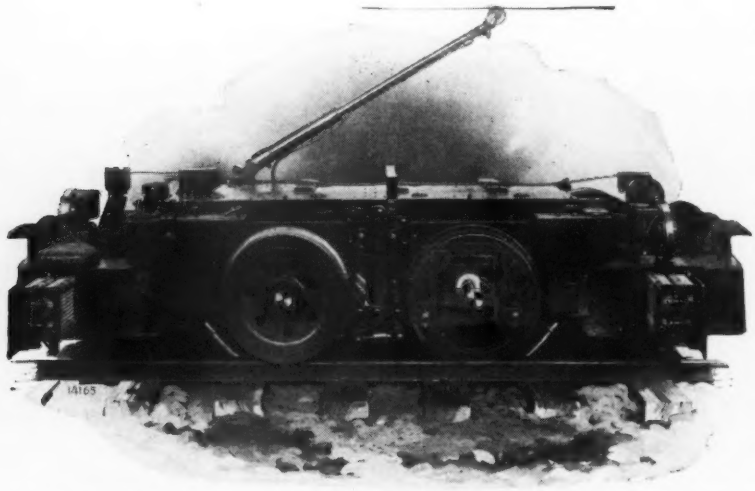


Note Threaded Bushing used to tighten grids, without changing length of sections



A Jeffrey 6-Ton Gathering Locomotive showing Hinged Resistance swung out of pockets for ready inspection

Note also phantom view of journal box showing long helical springs which give flexibility to the locomotive

These features make the Jeffrey Locomotive Resistance a thoroughly practical resistance for mine service.

Heavy Brass Clamp Terminals—Have large electrical and thermal capacity. Cable connections once securely fastened under these clamps stay secure.

Large Current Capacity — Especially on the last three points of the controller where there is greater likelihood of operating the locomotive for any appreciable time.

Special Alloy Iron Grids—Three extra heavy Through Rods provide a rigid and properly balanced support. Substantial insulation throughout.

Heavy Malleable Iron End Plates—Form a very strong support for the entire resistance unit.

Tightening Nut—For maintaining proper contact pressure between grids. Excessive heating and accelerated destruction of the resistance units due to loose and poor contact between the grids is offset.

The Jeffrey Mfg. Co., 958-99 North Fourth St., Columbus, Ohio

New York, Philadelphia — Pittsburgh, Scranton, Pa. — Charleston, W. Va., Chicago — Denver, Salt Lake City — Birmingham, Montreal, Canada

Sales and Service Stations

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Jeffrey-Standard Coal Mine Equipment

Coal Cutters
Combination Cutter and Loader
Drills
Conveyor-Loader
Sectional Conveyor
Pit Car Loaders
Locomotives
Mine Fans
Tipple Equipment
Crushers

THE MINING CONGRESS JOURNAL

JULY, 1926

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$3.00 Per Year
30c Per Copy

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PRACTICAL OPERATING MEN'S DEPARTMENT

METALS

Flotation Progress At Britannia

COAL

Timber Preservation At Primero Mines

Preservative Treatment of Mine Timber

Published Every Month by the American Mining Congress, Washington, D. C.

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Field Representative

Entered as Second Class Mail Matter January 30, 1915, at the Post Office at Washington, D. C.

Do You Mine More

FROM the latest pumping statistics, the coal mining industry as a whole "mines" 3½ tons of water for every ton of coal produced. The efficient, economical handling of this enormous tonnage makes mine pumping more important—as a *material handling* operation—than the coal conveying problem.

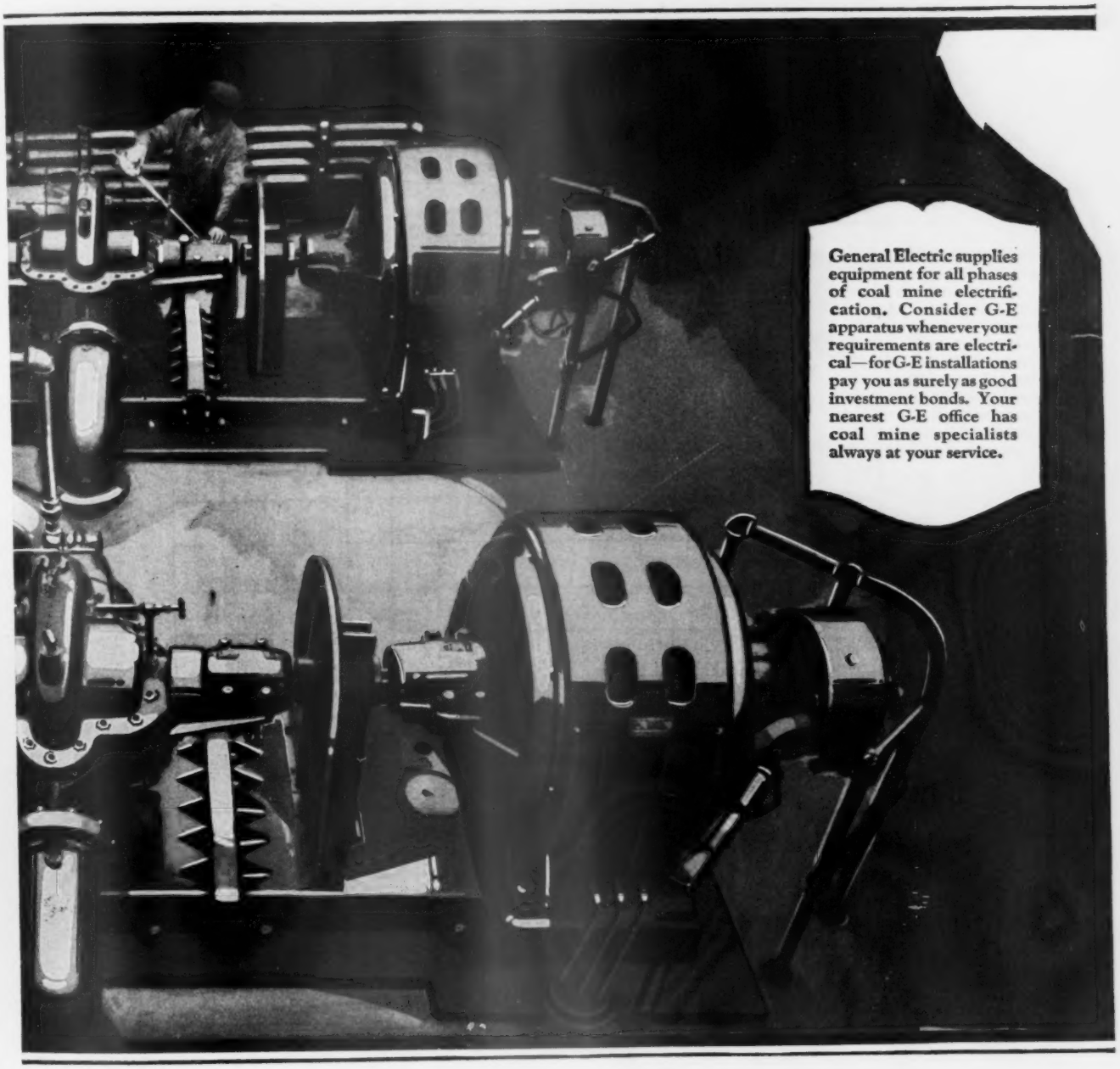
Your pumping requirements therefore deserve the best equipment and the most thorough engineering study available. Modern automatic pumping is a job for electricity—and G-E Motors and Control.

G-E engineers, trained in the field, will gladly help you select the sizes and types of motors for mine pump duty. Ask your nearest G-E sales office for this service

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

Water than Coal?

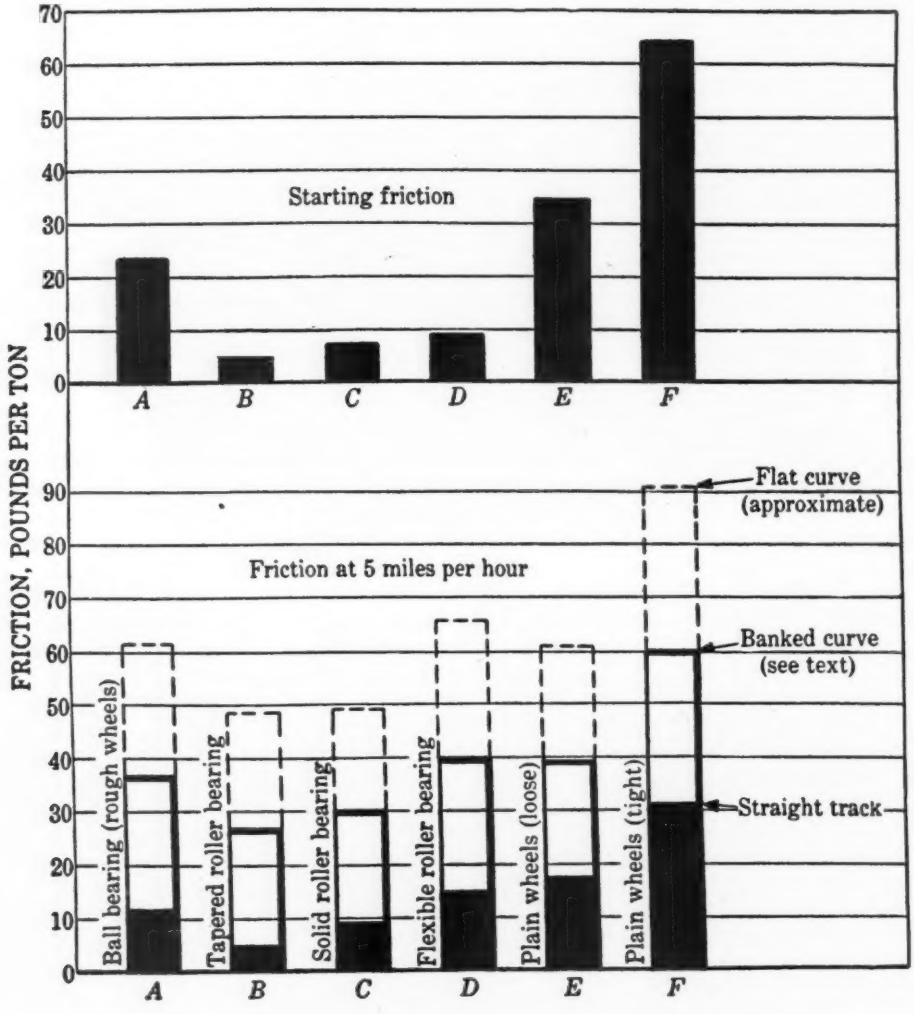

General Electric supplies equipment for all phases of coal mine electrification. Consider G-E apparatus whenever your requirements are electrical—for G-E installations pay you as surely as good investment bonds. Your nearest G-E office has coal mine specialists always at your service.

7A-6

ELECTRIC

SALES OFFICES IN ALL LARGE CITIES

Least Friction



Comparative friction of six types of mine car trucks is charted in Figure 6, Bulletin 20, (corrected by supplementary data) covering official tests made under the auspices of Carnegie Institute of Technology, United States Bureau of Mines, and Mining and Metallurgical Advisory Boards.

by Official Test

FROM BULLETIN 20, CARNEGIE INSTITUTE OF TECHNOLOGY, UNITED STATES BUREAU OF MINES, AND MINING AND METALLURGICAL ADVISORY BOARDS—

"Of all the trucks tested, truck B* was the only one to coast beyond the end of the curved track. In test 34 the final velocity was observed to be about 2 miles per hour, from which the friction was computed equal to 27 ± 2 pounds per ton. Following this test, a 10-ft. section of track was placed at the end of the curve, and elevated to a slope estimated at between 1 in 10 and 1 in 6, to serve as a bumper. In test 38 the car travelled 7 feet up this incline, from which the friction was computed equal to 16 ± 10 pounds per ton. That the friction of the truck* in these tests was exceptionally low was clearly evident without computation from the fact of its running off the end of the track." (PAGE 18.)

"The tapered roller-bearing truck* appeared to have the least friction of any, amounting to about 0.3 of the average friction on straight track, and about 0.8 of the average on curved track." (PAGE 31.)

*Equipped with Timken Tapered Roller Bearings

ON the straightaway, on flat curves, on banked curves, and in starting, there is less friction in Timken-equipped mine cars. This was determined in laboratory tests of all types of bearings, as detailed in Bulletin No. 20 of the Carnegie Institute of Technology, United States Bureau of Mines, and Mining and Metallurgical Advisory Boards.

The positive roll alignment of Timkens, their scientific absorption of thrust, and the inflexibility of Timken-made steel do mean minimum friction, with great savings in labor, power, lubricant and replacement.

If friction were the only test Timkens would win. But you also want the high load capacity, the permanent alignment, the compact simplicity, and the perfect enclosure of Timken mountings, which retain a full year's supply of lubricant. Because they are so much *more* than anti-friction bearings, Timkens prevail so heavily throughout mining today.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

Old Bridge in Shenandoah Valley, Va., built in 1872-73 by the Baltimore and Ohio Railroad. This, with two other bridges of equal age, remained in service over half a century without reinforcement or repair. The WROUGHT IRON members showed no loss of section through corrosion, although they had not been painted for 23 years.

50 Years Old---
No Paint in 23 Years---

yet corrosion did no harm!

SUCH is the record of the genuine wrought iron members on this old bridge in the Shenandoah Valley, Va., described by P. G. Lang, Jr., Engineer of Bridges, Baltimore & Ohio Railroad. Such performance is characteristic of wrought iron—the kind of metal which has always been used in the manufacture of Byers Pipe.

In buildings of every character; on railroad cars and locomotives; in power plants, factories, mines; under and above ground, Byers Pipe when used for conveying water, steam, and other fluids shows the same astonishing resistance to corrosive attack.

Ask for Literature

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Established 1864 PITTSBURGH, PA.
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Roebling
Wire Rope

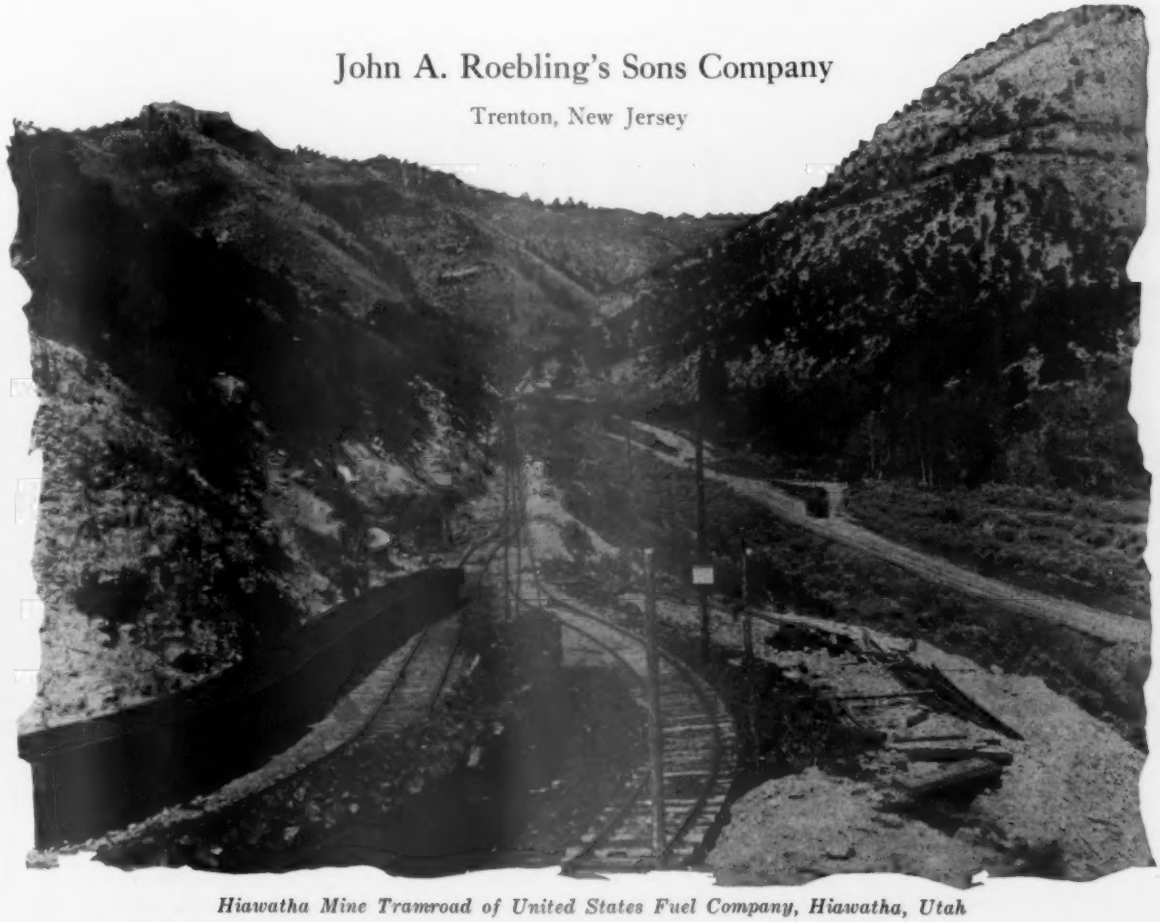
Most wire ropes look the same, but what a difference in results!

In mining, exceptional conditions exist which must be met by the use of wire rope possessing exceptional qualities.

Roebling Blue Center Steel Wire Rope possesses these qualities. It is made of a superior grade of steel produced in our own furnaces and is fabricated by skilled workmen, under expert supervision.

John A. Roebling's Sons Company

Trenton, New Jersey

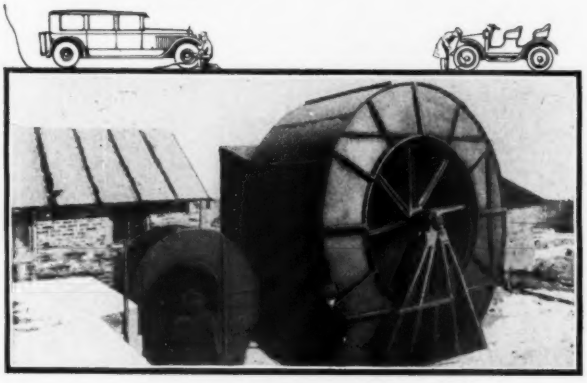


Hiawatha Mine Tramroad of United States Fuel Company, Hiawatha, Utah

Bringing Air Up to Date

When installed 25 years ago, the Robinson Steam Fan illustrated to the right was the last word in ventilating efficiency. Today the newer and smaller Robinson Motor-Driven Turbine Fan delivers more air — and saves money in the doing!

May we tell you how modern Robinson Fans can cut your ventilating costs?



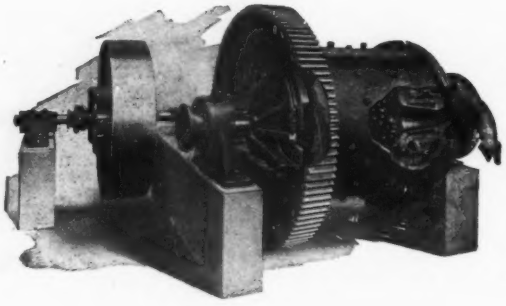
New Robinson 5-ft. Motor-Driven Turbine Fan alongside the Robinson 12-ft. Steam Fan it replaced at the Winburne Mine of the Pennsylvania Coal & Coke Co., Cresson, Pa.

ROBINSON
House Bldg. Ventilating Co. Pittsburgh

Antiquated equipment costs money—more money than modern and better equipment. Andrew Carnegie realized this and it became one of his cardinal principles of success

TELL US YOUR VENTILATION NEEDS. OR BETTER YET, LET US SEND AN ENGINEER TO SURVEY YOUR MINE. NO OBLIGATION

BALL GRANULATORS



DESIGNED by engineers who are familiar with the work for which the machine is intended—

PERFECTED by careful research experimentation and co-operation with our customers—

FURNISHED where continuous operation and economy are the first considerations—

FABRICATED with usual high-grade material and workmanship that characterize all ALLIS-CHALMERS products.

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MILWAUKEE, WISCONSIN, U.S.A.
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Power Transmission Machinery
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Steam and Electric Hoists
Air Compressors - Air Brakes
Agricultural Machinery
Condensers

Distinguishing Features

These distinctive features assure long life, safety, power and easy operation to the Vulcan Storage Battery Locomotive.

Equalizing Levers

By means of equalizing levers, links and bell cranks the inner ends of the springs are connected. Thus the same equalization of pressure on the journals, as secured for the Vulcan Trolley and Steam Locomotives, has been made possible for the Vulcan Storage Battery Locomotive.

Worm-Gear Drive

By means of a segmented shaft, flexible couplings and worm gearing, motion is transmitted from the single motor to the driving axles. Thus is utilized a type of drive the utility of which has been proven in motor trucks, tractors, etc.

Self-Locking Brake

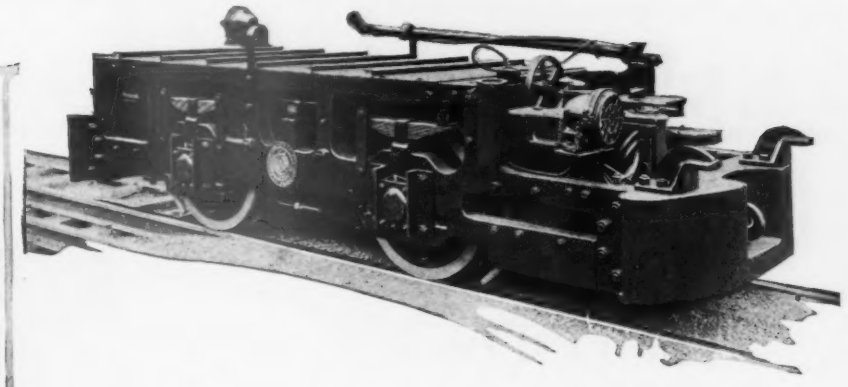
A quick-acting, self-locking brake, similar to that of the Ford automobile, makes sudden stops a simple operation for the driver. Throwing a lever, which actuates a cam, through a half circle, applies or releases the brake.

Cast-Steel Bar Frame

Maximum strength, minimum weight and ample ventilation are secured by the cast-steel bar frames on each side of the body.

Vulcan Products

Hoists, Electric and Steam
Locomotives, Steam, Gasoline, Electric
Rotary Kilns, Dryers, Coolers and Roasters
Fairchild Double-Discharge Ball Mill
Mine Ventilating Fans
Cages and Skips
Sheave Wheels
Corliss Engines
Coal Crushers
Gray Iron Castings
Open Hearth Steel Castings
Gears, Moulded and Cut Teeth
Special Machinery



Sharp curves—
What if there are?

No danger of derailments around sharp curves when a Vulcan Trolley Locomotive is doing your hauling. Due to the 3-point suspension of the chassis and other shock and strain absorbing features, this Vulcan Electric Locomotive adjusts itself to sudden turns as well as bumps and abrupt grades. The service life is prolonged just as the life of the Vulcan Steam Locomotive which has records of 30 and 40 years on a job.

Look over the features listed in the panel on this page and send for the story complete.

VULCAN IRON WORKS
WILKES-BARRE, PA.

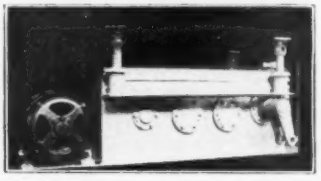
New York: 50 Church St.
Chicago: McCormick Bldg.

Established 1849.

VULCAN IRON WORKS OF Wilkes-Barre, Pa. U.S.A.
STEAM GASOLINE ELECTRIC LOCOMOTIVES

"*IT IS NECESSARY that all machinery, including as well the drive end of the main conveyor, be SILENT IN OPERATION.*"

—*Proceedings, 1926 Cincinnati Coal Convention.*



The LODWICK
CONVEYOR DRIVING ENGINE

drives the conveyor troughs with a slow, even stroke, conveying coal or other material, large or small chunks, **silently** and **effectively,** from 20 to 60 feet per minute, depending upon requirements for the layout. It meets this newly recognized safety requirement of silent equipment. Let us tell you more about it.

We invite you to visit our experimental mine at Centerville, Ia.

CENTERVILLE EQUIPMENT INCLUDES
Lodwick Reversible Mine Fans
Long Wall Conveyors
Dirt Dump Equipment
Dumping Cages
Weigh Pans
Coal Chutes
Shaker Screens
Mine Cars

THE CENTERVILLE FOUNDRY & MANUFACTURING CO.
CENTERVILLE, IOWA

MAKERS OF POWDERS SINCE 1802

A power plant of 1802 when the first du Pont powder mill was built

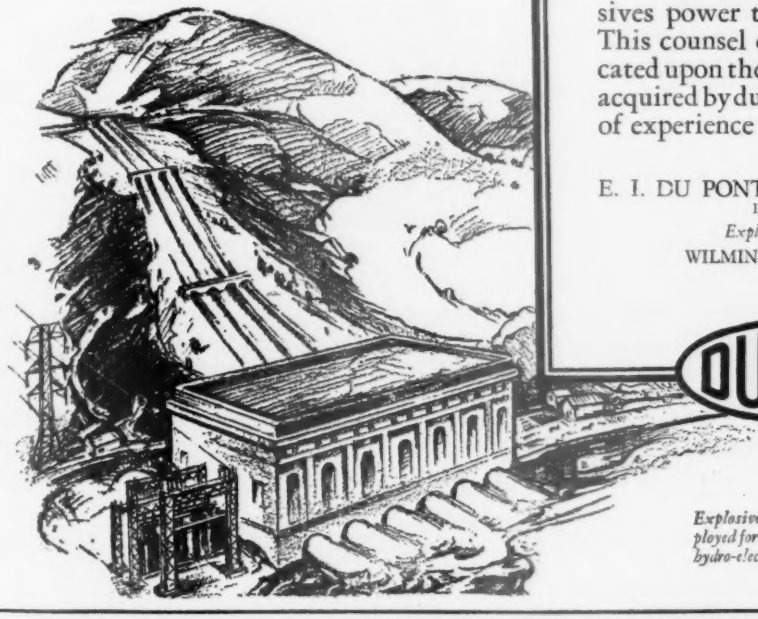
Counsel—

There is a more efficient way to do everything. This is particularly the case regarding the selection and use of explosives involving a definite outlay of money, energy and preparation.

Du Pont Technical Field Service offers to explosives users the co-operation of men skilled in the selection and application of explosives power to blasting problems. This counsel or assistance is predicated upon the extensive knowledge acquired by du Pont during 123 years of experience in manufacture.

E. I. DU PONT DE NEMOURS & CO.
INCORPORATED
Explosives Department
WILMINGTON, DELAWARE

DU PONT



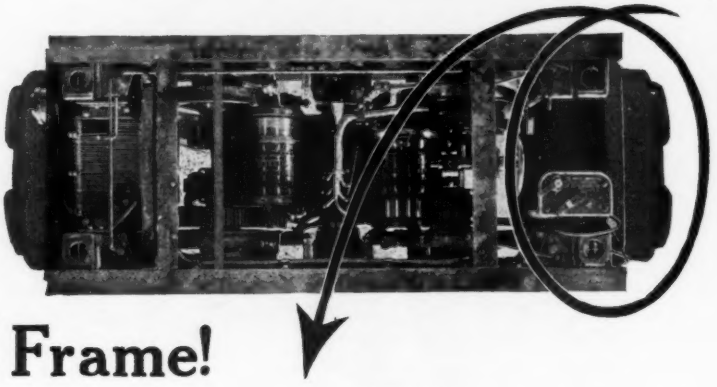
Explosives power is extensively employed for construction of the gigantic hydro-electric plants of modern times

123 YEARS OF LEADERSHIP IN THE SERVICE OF INDUSTRY

Goodman Locomotives

Save Labor
Save Dollars

Why?



5---Look at the Frame!

AXLE BOX GUIDES
Heavy steel.
Renewable.

SIDE PLATE
Heavy rolled steel.
One piece.

END PIECE
Annealed cast steel.
One piece.
Machined, shouldered fitting.

LIP LUGS
Large, to prevent climbing of cars.

BINDER
Heavy steel.
Machined, shouldered and bolted.

SPRING BUMPER
Annealed cast steel.
Affords cushioning effect through 1½ inches of spring action.
Acts in either pushing or pulling.
Cupped at corners for poling cars.

RIGID CORNER CONNECTION
Side plate and end piece secured by hot bolting or hot riveting.
Long contact of end piece along side plate assures great corner strength and frame rigidity.

SHOULDERED CORNER
Side plate and end piece machined to perfect fit.
End piece shoulder bears against end surface

FLOOR PLATE
Cast integral with end piece or hot-riveted to it.

The Frame is the Housing for all Working Parts and is the Basis of Good Performance

(13)

GOODMAN MANUFACTURING COMPANY
PITTSBURGH
CHARLESTON, W.VA.
ST. LOUIS DENVER
4746 to 4854 South Halsted Street
CHICAGO, ILL.
CINCINNATI
HUNTINGTON, W.VA.
BIRMINGHAM

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MINING CONGRESS JOURNAL

PUBLISHED EACH MONTH BY
Subscription Rate: Per Year, $3.00

THE AMERICAN MINING CONGRESS

MUNSEY BLDG., WASHINGTON, D. C.
Single Copies: $0.30

VOLUME 12 JULY, 1926 VOLUME 7

THE NEXT TAX PROGRAM

REDUCTION of the corporation income tax rate should be placed first on the next program for revision of the Federal tax law. There has existed for several years a severe discrimination against the corporate form of business, and this discrimination has been greatly increased by the reduction in normal and surtax rates made by the revenue act of 1926, and the increase of 1 percent made in the corporation rate for the purpose of commuting the capital stock tax. This placed an added burden upon fewer enterprises carried on in corporate form, and increased the differential taxes imposed on corporations as compared with individuals and partnerships. Economic conditions will compel the next Congress to give serious consideration to this phase of the tax situation.

Corporate industry must be permitted to function without having to carry along the drag of an unjust tax handicap. That handicap must be removed if corporate industry, the backbone of the nation's business, is to prosper under normal conditions. The point has been reached where Congress must recognize and eliminate the inequalities that now exist under the Federal tax system, and which operate to depress industrial activity and growth. That is the situation now; it will become more acute during the next few years unless steps are taken to correct it. The present discrimination was not due to any intent on the part of Congress or the Treasury to penalize corporations. It was merely the result of what had to be a piecemeal program of reducing the enormously high war taxes. For that reason there has been no general complaint. Taxpayers operating in corporate form have been willing to cooperate with the Government in carrying out its policy of reducing taxes gradually and in such a manner as not to jeopardize the revenue yield necessary to prevent a Treasury deficit. But now that every other class of taxpayers has been taken care of, those engaged in corporate enterprise have a right to expect relief. They have patiently awaited their turn, and they are now next in line.

Second in importance to a reduction in the corporation rate is the simplification of the administrative provisions of the law. All commentators on the Federal tax system recognize that the administrative provisions of the law are cumbersome and confusing; and that departmental procedure, established by the administrative regulations designed to carry the law into effect, is highly involved and beyond the understanding of the average individual. The fact that the Treasury Department has been able to function successfully, in that it has collected annually billions of dollars in revenue, speaks well for its officials who were charged with responsibility for administering the law, but does not justify in the least an assumption that the law itself can not be amended to make the task easier. And, irrespective of whether or not the Department has been able to perform well the duties imposed upon it, a fair presentation of what taxpayers have had to endure should convince Congress and its Joint Commission on Taxation of the necessity for early and, perhaps, radical revision of the administrative system.

INDUSTRIAL COMBINATIONS

THE declaration of Col. W. J. Donovan, assistant to the Attorney General, at the annual convention of the New York State Bankers' Association, that there is a "beginning of the same resentment towards consolidation of industry that was so evident against combinations of the early nineties," is an opinion that might be expected from any representative of the Department of Justice who has been connected with antitrust prosecutions. We disagree with Colonel Donovan. We believe, on the contrary, that the public is beginning to realize that in order to stabilize our basic industries some consolidation of industry is necessary in order (to paraphrase another statement of Colonel Donovan) that capital may be massed and assembled for sound economic purpose that a better public service may be rendered. To this end, sentiment is growing in favor of modification of the Sherman antitrust law. Of course, there would be resentment against combinations calculated to violate the competitive principle in business, but there is little tendency in this direction, especially among the leaders in our large basic industries.

In contrast with the attitude of Colonel Donovan, many of our national legislators hold the view expressed in a recent public address by Representative Joe J. Manlove, of Missouri, who, after reviewing the ills of the coal industry, said: "With these conditions in mind, it is evident that there must be closer organization before there can be a continued prosperity in the industry. Undoubtedly the enactment of more elastic provisions of the antitrust laws, which would permit, although probably under Government supervision, such agreements and consolidations as would tend to stabilize the bituminous coal industry, would be to the interest of the producer, the miner, and the public. Consolidations would tend to insure the continuous operation of low-cost mines and also steady employment for labor."

We have found no evidence of public resentment against consolidations in industry that are necessary to insure continued industrial prosperity and growth. The fear that prompted the antitrust legislation of 30 years ago does not dominate public opinion at the present time. The public is beginning to realize that the greatest relief that may be expected from present high prices for the necessities of life will come through business combinations and consolidations that are necessary in order to reduce overhead costs and costs of marketing, and to eliminate waste of economic effort through better coordination of agencies of production and distribution.

THE DECISION UNCHANGED

IN 1917 Congress was asked to legislate for permanent coal control. It had as an alternative to vote for coal price control for the period of the war. It decided to legislate for the period of the war only. The Congress at that time easily might have made a mistake. The whole subject of coal was then new. And members of Congress had many other and bigger problems before them. So the chances for error were large. Congress took the wise course and postponed final action on that vital resource until a better time. However, its opinion at that time was that control of coal prices even for the period of the war was a serious undertaking; to attempt to control them permanently would be a grave mistake.

The war-time regulation having expired by limitation, Congress was asked to legislate for permanent control of coal prices in 1919. It refused, at that time, to act, because it said that this suggestion was clearly a persistence of the war thought and that the proposal concealed a plan to perpetuate the war machinery. However, it then thought that permanent control was a dangerous thing because temporary control had been obviously of no benefit to the country, but to the contrary.

The same question came before Congress again in 1920. At that time an interruption of transportation had shortened the supply concurrently with a sudden expansion of demand—among other things, the exportation overseas of nearly 22,000,000 tons—both of which had disturbed price tendencies. Congress was asked to make such things forever impossible by legislating to resume coal price control—to define profiteering and to legislate it out of existence—and to set up artificial production and distribution. Congress decided then that such an abnormal period was no proper occasion for the promulgation of a permanent policy touching a vital natural resource.

Again in 1922 Congress had the coal question before it. There had been a strike of the coal miners. They had been joined by groups of railroad workers. The supply of coal of the nation had been seriously interfered with. It was proposed that it legislate to put an end to these things. Congress hesitated because it did not know exactly what could be done to end strikes or what effect from such measures, if taken, would follow. It had thought matters over for five years. It could not see that there was any law which could be injected into the coal situation to correct it. Still, at that time, it said that there were certain matters upon which it was not fully informed; it should be informed. So Congress arranged for a coal commission to study those obscure phases of the subject and to report back. That report was submitted. While it was voluminous, to the point of being verbose, it failed to disclose anything which Congress might do that would end strikes, pay the operators a profitable price, and still bring down the price of coal to the consumer.

On all of those all-but-forgotten occasions the Congress may have made a mistake in reaching its decisions. The times were turbulent. The thought of everybody about the coal business was aroused and intense. Under such circumstances it easily could have made a mistake due to passion. However, the same Congress has just been through another debate of the same question. This last time there was not a ripple anywhere on the surface; there was nothing to disturb the thought of anybody. The supply of coal was abundant. The price charged for coal was reasonable. The wages paid to the coal miners were the highest in history and higher than those paid by any other industry for anything like the same class and grade of work. With the public indifferent to the coal question, Congress debated it in cold blood. It went back over exactly the same ground that had been covered in all of the other hearings. And, in the end, reached the same decision as that at which previously it had arrived. This was that nothing suggested itself as a cure for the so-called coal problem. Indeed, there seems to have developed no coal "problem" from a legislative point of view.

But it must be understood that Congress on each occasion has been considering primarily the production end, and the trouble has not been found there. The facts concerning the producing end of the coal business indicate that Government regulation or control is not what is needed to make coal cheaper to the consumer. That is why Congress has not acted. America has a great abundance of coal. Those who own active mines today have to compete not only with the other active mines but potentially with all of the mines that ever have been opened or which might be opened into our vast reserve of coal. There is no way to control coal without holding that reserve coal in reserve.

Six times the same subject has been debated. Six times the same reasoning dictated the same decision.

EVOLUTION IN AMERICAN INDUSTRY

PRODUCTION in American industry has been increased tremendously in recent years by the radical changes that have been made in basic policies of production management in the nation's industrial plants. Wisely invested capital, intelligent invention, elimination of lost motion, utilization of what formerly was waste, and efficient functional management have resulted in remarkable growth in industry, notwithstanding serious economic handicaps.

Labor is more productive than it was 20 years ago. This is almost entirely due to the application of machinery, which has increased the efficiency of the individual worker and has increased production while reducing, at the same time, costs of operation. This is particularly true of the mining industry. Mine operators have been compelled to resort to the use of mechanial appliances in order to survive under the severe handicaps of high wages, high freight rates, high taxes, highly competitive markets, and high interest rates on borrowed capital.

The coal mining industry of Great Britain is in desperate straits. Britain's mines are not mechanized. Mining methods are woefully antiquated as compared with those prevailing in America's coal mines, which are being continually improved. And Britain's unions have decreased the output per man to such an extent that it is impossible for the mine operator to compete in the world's markets. It is a matter of record that the coal miners of Great Britain are putting out three-sevenths of the coal they produced in 1913 and 25 percent less than they produced five years ago.

In the bituminous fields of the United States the union fields have been losing steadily to the nonunion fields. Wise labor leaders should take cognizance of the facts. Instead of preaching less production per man, they should advocate increased production; instead of opposing the installation of mechanical devices, they should urge the most complete mechanization of mines and the utilization of the latest approved methods and devices. Thus only can they hope to make present high wage scales permanent and in accord with what the mine operators, and the public, are willing to pay—the highest possible wage consistent with industrial development.

It has been demonstrated that mechanization of mines results in less men employed in the industry, greater output per man, less physical labor on the part of the worker, and greater safety for the workers employed underground. The fact that less men may be needed is no reason for opposing mechanization, because the labor shortage in other industries will absorb the surplus of labor at present engaged in the coal mining industry the moment that surplus is compelled to seek other employment, and that will be when it can no longer depend upon two or three days a week in the mines at present high wages.

Mining costs can be reduced to a minimum only by utilizing modern mechanical devices, by adopting available improved methods of mining, by securing the aid of specialists experienced in applying engineering analysis and planning to the problems of management, and by standardization and coordination of the work of the individual mine worker, and by better control and coordination of underground operations. These can produce economies that in the aggregate will have a very important bearing upon costs.

Although many mining companies are recognizing these facts, the progress of the industry as a whole along these lines has been much slower than experience and evidence warrants, and hundreds of mines may be found whose cost sheets show that production is much less than it should be to justify the costs of their operations. Mine managements owe it to their stockholders, mine workers owe it to their employers, to allow nothing to stand in the way of mine mechanization, application of improved mining methods, standardization and coordination of underground operations, and the introduction of all economies that will secure lower costs and more efficient performance.

SAGACIOUS LEGISLATION

THE passage of the potash bill by both Senate and House provides for joint investigation of our potential potash resources by the Geological Survey and the Bureau of Mines and marks an advance in the movement for national independence in our potash requirements.

The Department of Commerce announced June 22 that the German dye trust had made further acquisitions of potash deposits in the Strassfurt area, and the press carries announcement of the rehabilitation and reopening of other properties by the same interests.

This not only links up the nonferrous metals cartel with large iron and steel groups in Germany but opens new chemical fields for competition. Bromine is a by-product of potash, and its use in dyestuffs, drugs, and photographic materials has been extended into new motor fuels.

While the present potash bill, which has gone to the President for signature, was under congressional consideration, 15 additional wells in seven west Texas counties and one county in New Mexico have yielded evidence of potash in commercial quantity.

The Department of the Interior now reports eight potash wells in Texas and two in New Mexico, of which five yielded more than 5 percent. The richest sample, containing 13.6 percent of potash, equivalent to 21.3 percent of soluble salts, was from Reagan County, Tex.

The systematic core drilling of the entire field in order that private capital may intelligently and willingly lay the foundation of an American potash industry, cooperating with the Searles Lake and other sources of potash, to supply our entire requirements, is an outstanding duty which we owe to the American people.

THE MOTHER LODE SECTION

FACED with high wages, low-grade deposits, excessively high cost of operation, and a fixed value for their product, the gold mining industry has suffered a loss in producing companies that is alarming. One by one, like so many gallant soldiers on the battle field, has company after company fallen from the producing ranks. But gold mine operators possess the courage that is inherent in all mining, and are determined to stem the tide of defeat.

One step is the recent formation of a Mother Lode Section of the American Mining Congress, which was organized on June 12, with 300 charter members. This district is one of the oldest of our gold producers, and has contributed a vast amount of wealth to the nation. The new organization will devote itself primarily to the problems of the Mother Lode. It so happens that their problems are also the problems of a considerable number of western mining localities, and their activities will be followed with interest by mining men. Among the subjects discussed at the organization meeting were methods of taxation, high-grading, and ways and means to rehabilitate the gold-producing districts.

While national issues facing the metal mining industry are not at the moment pressing, it is an exceedingly propitious time for serious consideration of state and local problems. When the trained eye of the nation is directed toward mining in a legislative way, local problems are allowed to drift. With the closing of Congress mining men may now devote their attention to those things that are more or less local.

In the metal mining industry there has always been a greater tendency to cooperate than in other branches of the industry. This may be because the metal industry is made up of a series of units that are noncompetitive. In almost every mining state there is a state mining association, which is made up of local state and district associations. In this way the mining men of the state are able to keep close tab upon conditions in various parts of the state. The state association in many instances is a distinct part of the Western Division of the American Mining Congress, which represents practically every metal-producing district in the United States. This enables mining men to become familiar with mining problems in all of the metal-producing states. Once each year the Western Division calls a convention to which come representatives of the various state associations. There problems are discussed, and resolutions passed that visualize mining conditions throughout the country. These resolutions are referred to the American Mining Congress, which represents coal and oil, metals and nonmetals, thereby establishing a clearing house of "Understanding" and enabling that organization to present to legislators, both state and national, a true picture of the mining industry. The result of such organization has been unity of action in the industry upon all problems of the industry as a whole.

Encouragement should be given this tendency of mining men to organize, to cooperate, and to confer with each other. The result can be nothing less than a better understanding of their problems and needs and a more sympathetic attitude from the public. We extend hearty welcome to the Mother Lode Section.

NO DEARTH OF ISSUES

THE mining industry, fortunately, has been able to deal successfully with most of the issues that have confronted it during the last few years when high costs, limited markets, high taxation, regulatory legislation, revision of freight rates, and other questions of more or less importance were exerting their influence upon sales, profits, credit, stabilization, labor relations, and general business conditions. The industry has won the public confidence through the fair manner in which its leaders have presented the facts to Congress and the Government departments, and because their requests have not been unreasonable or improper. Many of the questions that confronted the industry during recent years therefore have been disposed of satisfactorily to all concerned—the industry, the Government, and the public. But vital questions still remain to be settled. And the industry dares not sleep.

If the mining industry is to be adequately protected from ill-advised and unfair legislation, preparation must be made in advance to have assembled all the facts pertaining to each question that is scheduled to come up. For example, the right of mines to use the waters of streams must be safeguarded; the rights of prospectors must be preserved in grazing districts of the west; the right to prospect for and develop minerals in the national forests must be relieved of restrictions; the Government policy regarding minerals contained in land grants must be more clearly defined and kept on a sound basis; friendly labor relations must be maintained in the mining industry by continuous attention to the causes of friction; the principle of promoting the greatest degree of safety for the workers in the mines must be encouraged; proposed regulation of the coal industry or other branches of mining through fact finding bodies or other governmental agencies, must be opposed if Government invasion of private business and curtailment of private rights is to be prevented.

The mining industry has to have a reasonable protective tariff; and, if the tariff is to be upheld, continuous studies of mining costs in relation to the tariff must be made. Stable currency, adequate protection for gold mining, and a fair price for silver, are matters that must have attention, and the industry must resist the efforts that are being made to establish what is known as the flexible dollar based on commodity prices. Taxation problems are not out of the way. It will require constant effort on the part of those representing the mining industry to prevent any further shifting of the tax burden such as has taken place in the past in some of the mining states, and such as took place when the capital stock tax was repealed and the corporation rate was increased one percent.

And overshadowing all of these things, those working for the best interests of the mining industry must continue to develop a workable program for constructive stability of the industry. If it is necessary to have the Sherman anti-trust law modified, efforts should be made toward that end. This is no time to rest, no time to cease thinking about the problems that confront the industry. There is enough to be done to justify the cooperation and concentrated effort of every branch of mining for the next two years. There is no dearth of issues now.

THE POINT OF VIEW

THREE men were candidates before the preferential primaries in Pennsylvania for the Republican nomination for United States Senator. The choice carried with it, to an extent, the leadership of the state organization of the party. That, in turn, carried with it something of a commanding voice in the national affairs of the party, and hence in the selection of presidential nominees. The issues involved were fairly large, and in consequence the battle was fast and even furious. Following the primaries, the inevitable investigation was held, disclosing the fact that the contest had cost a considerable sum of money. This was followed by the inevitable discussion with its background of suspicion and all but open charges of corruption. Those things are, of course, but the froth on the brew. The real question lies considerably deeper.

The most interesting part of the whole discussion was the point of view from which the various incidents were treated. From this voluminous discussion, it seems to be quite all right for these gentlemen to contend with each other before the public for control of this powerful political position. One would judge that it was even considered all right for the successful gentleman, once he was in office, to use all of that amazing power to impress his own personal and private views upon such a great state as Pennsylvania, and through it upon the whole of the United States. For the six-year term, a Senator draws in salary the total sum of $60,000. It is known, of course, that a preferential primary campaign, especially where there is a contest, in a large state costs more than that sum. The campaign preceding the election which follows also costs far more than that. So if the Senator is forced to spend all of his salary for the nomination and all of it again for the campaign before the election, he ends up by serving for nothing and by being in debt for his total salary—to himself or somebody else—and after he enters office he has no chance of recovering a dollar of it. That sort of thing bars the doors forever to another Lincoln.

The law provides for the preferential primary. It is known and is obvious that that primary costs money. It is known that no ordinary citizen can pay twice his total salary to have himself nominated and elected. It is known that without spending that amount of money any candidate would remain almost unknown. But when it comes to a good man getting money from other good men to help pay the bill for what is obviously a good thing in politics—"good" because it is provided by law—the gentlemen who raise the money are criticized for having done so. And that supplies the basis for the charge of corruption.

In the campaign in question there was at issue a question of taxation. Men who already are taxed until their business can hardly stagger under the load said with commendable candor that they raised the money which was necessary to see that a man was nominated who would not increase their taxes. They have told the Senate committee and the public that they are not tax dodging; they are merely fighting unjust taxation.

So it happens that the comment upon this situation is colored quite largely by the point of view of the commentator. It would seem to be next to impossible to get the truth of this whole big question by merely discussing it from a single point of view. The first truth that falls out is that ours is an expensive method of choosing candidates. If we object to that expense and to the inevitable ways of raising the money to meet it, we should devote ourselves religiously to the search for a cheaper method of procedure.

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Washington's Speedway—three miles of automobile road and bridle path along the Potomac flanked by flower beds and the famous Japanese cherry trees.

MOTHER LODE SECTION ORGANIZED

Mother Lode Mining Men Met At Sacramento, California, On June 12, To Form Section Of American Mining Congress—C. E. Jarvis Elected Governor—Resolutions Adopted Deal With Pertinent Problems Of The District

MINING men of the Mother Lode district of California, which comprises the foot hills and mountainous section east of Sacramento, met in that city on June 12, to organize a section of The American Mining Congress. The arrangements for the meeting were made by E. G. Reinert, Pacific Coast Representative of The American Mining Congress. The purpose of the organization of this section is to bring better conditions for the conduct of mining operations on the Mother Lode, and to stimulate constructive action and cooperation of all men interested in mining in this district. The meeting closed with a membership of approximately 300; resolutions were passed, and officers elected, as follows:

Clarence E. Jarvis, Governor, (Amador County); Fred G. Stevenot, First Vice-Governor, (Calaveras County); James D. Stewart, Second Vice-Governor, (Placer County); H. E. Dillinger, Third Vice-Governor, (El Dorado County); Charles G. Johnson, Secretary-Treasurer, (State Treasurer of California).

BOARD OF GOVERNORS

Amador County—

M. J. Bacon, Ione, Calif., (Non-Metallics); John F. Davis, San Francisco, Calif., (Metallics); A. S. Howe, Sutter Creek, Calif., (Metallics).

Calaveras County—

F. J. Estep, Jenny Lind, Calif., (Metallics); Joseph A. Montreville, Angels Camp, Calif., (Metallics); Fred G. Stevenot, Carson Hill, Calif., (Non-Metallics).

El Dorado County—

C. N. Brust, Kelsey, Calif., (Metallics); S. W. Collins, Garden Valley, Calif., (Metallics); H. E. Dillinger, Placerville, Calif., (Non-Metallics).

Mariposa County—

E. W. Bagby, Bagby, Calif., Metallics); H. J. Kelm, Bagby, Calif., (Non-metallics); C. E. Kocher, Merced, Calif., (Metallics).

Placer County—

M. J. Dillman, Lincoln, Calif., (Non-metallics); J. Earl Lukins, Auburn, Calif., (Metallics); James D. Stewart, Auburn, Calif., (Metallics).

Tuolumne County—

J. V. Goulardt, Toulumne, Calif., (Metallics); H. Haueter, Chinese Camp, Calif., (Metallics); Claude Scanavino, Tuolumne, Calif., (Metallics).

Contiguous counties may receive official representation in this organization when 25 or more members to The American Mining Congress have enrolled for that purpose.

E. G. Reinert, in outlining the purpose of the meeting said:

"In prefacing a few remarks regarding the purpose of this meeting, it may be desirable to direct your attention to the fact that this national organization of which you are a part has accomplished much during the 25 years of its usefulness. Simply told, The American Mining Congress is the business representative of the mineral industries at our National Capitol; there to represent its needs and logical demands; to secure for it the recognition it deserves as a fundamental industry; based, however, upon its true relationship to other essential industries; financial, industrial and commercial. It is not in the least concerned with partisan politics. It is a free lance, expounding only the religion of natural resource development and manufacture to the end, that the human race may best be served. We are proud of its purpose, and as members, we are proud of its record. To the uninformed, let me say that if every man from the highest pinnacle of the Sacramento Valley watershed to the lowest plains dipping underneath the Bay Cities into the Pacific Ocean, fully appreciated the work of this organization, he would need no urgent invitation to affiliate therewith. The truth about mining is its only concern, realizing that then and then only will the right conditions exist for its better conduct. Let me add that the truth alone will make men brothers, and is in the last analysis, the final remedy for all our troubles. I have no authority to state, that The American Mining Congress is the ex-officio Federal Department of Mines; but it is. Its established position beyond the pale of political intrigue alone entitles it to that distinction.

"We are here a representative body of business interests in mining; not a prejudiced phase of the industry nor a group of special interests. When we speak of industry, we speak concretely of men, not of elements and things. Lets forget for the once that rock is hard—and crack our heads together for a while. It will do a lot of good if we stick to the text. I should like to say very many nice things about the greatest mineral territory exposed on this old Earth's surface, as I saw it on a better than three thousand-mile trip throughout the Mother Lode country of California—a land of plenty above and below the ground; its wooded hills, rippling waters, fruits, flowers and mountains of gold dressed in non-metallic splendor, affords all the elements for the eye, ear, nose and throat to make man function as the king of the universe. Words are without meaning to describe that land of blessed opportunity. But we must get to the more serious phases of existence.

"While many new mines are in the making from the grass roots, what has happened to many of the old ones deserves our consideration as to its bearing on the situation. They are mute testimony to the great successful future of mining throughout this territory. For one thing, apart from the tremendous production of gold—exceeding the billion dollar mark—they present the degree of efficiency attained in the high-grading art on this mundane sphere. Not only has the miner done his share of relieving his employer of specimen rock but some old managements have been guilty of far greater depredations toward the industry. Not that they robbed themselves or associates of immediate values, but rather by introducing the asinine policies of attempting to keep production up even or ahead of development, if that were possible, and permitting profits to be dissipated without providing adaquate sinking funds for future exploration. Thus surface enrichment to a comparatively few hundred feet in depth was greedily mined to satisfy a get-rich-quick spirit of stockholders or owners. Managements able to withstand such temptations, are still successfully mining at constantly greater depths and under price conditions far less favorable for their product. Keeping positive ore reserves well ahead of mill capacity and cash ore-finding reserves always available, has made a number of mines on the Mother Lode young mines at a ripe old age; proving the folly of idle talk about exhausted mines. The truth will eventually leak out to mining men and investors the world over and every dormant mine on the Mother Lode will again come under successful operation. To learn from the past is the part of wisdom, but to accept doggedly its teaching as a criterion for the future, is the folly of the knocker. Give the Mother Lode a chance and it will soon prove its position as a world character by production records

that will equal if not outclass South Africa. In the meantime, in its East and West Belts, many good prospects are forcing themselves to public attention, with rich rock often in sizable quantities. Prospect mills of small capacity are in evidence in every community, facilitating the building of many new and profitable enterprises of the future.

"There is much good to be accomplished by coordinating the industry throughout the Mother Lode. The first step toward securing better conditions for the conduct of the industry is a friendly cooperation of all interests. We are taking this step today. Discussion of our mutual interests and problems by reason of its constructive nature, is an activity that will safely remove the knocker from our midst in all communities and gain for the industry its full share of public consideration.

"Attacking our problems from a business angle is fundamental to enlisting public cooperation. Upon how well we attend to our business will depend the result. Harmony and friendship within our ranks in every community will beget a public confidence in our activities. Basing that confidence on fact—the truth—cannot be done by an unorganized mob. There must be a unity of purpose. Taking the public into our confidence can only be done when mining is no longer hedged about with suspicion on the part of some men in public places. This brings us squarely up against a modern theory of government that is contrary to American ideals.

"Commissions to regulate are a studied effort to rule by force rather than intelligence. The old fashioned use of the word 'regulate' applied to the control of children, is a glowing example. Appealing to stupidity instead of human intelligence is a slam on civilization and Americanism. It is the child of selfishness. The citizenry is being taken to a spanking. It has been shown that the peoples of Europe vote from 60 percent to 85 percent of the populace, while in the United States but 50 percent is the average. But why vote when you will be regulated instead of reasoned with. Regulation by commission is not law, but like the Irishman in jail, we are in for it. Someone with the inclination, time and money, who is not beholden to the old order of rule or ruin, will ultimately test the commission form of government in the higher courts, when it will be properly tagged as opposed to the benefit and freedom of an intelligent people.

"To protect the public, the simple way out will be to go back to the enforcement of the first principles of fundamental law and burn in effigy all superfluous measures, regulatory statutes, and vicious regulations. Plain every day Americanism must take their place. The whole truth is the only remedy. It will bring the tax question down to a stable basis; put the stock fakir out of business—he cannot exist upon it; it will take tyrannical power and patronage out of the hands of designing politicians and force a new order of business ethics. Then the investor will be protected through his own intelligence. The truth may be easily arrived at under oath by governing officers of corporations. Periodical reports covering financial and physical status in detail, placed on file with a proper State Department and available to public inspection, or transmission under affidavit by the proper State official when accompanied by a transcribing fee, will place investors and speculators in possession of exact knowledge. Their own better judgment must then rule with no 'come back,' claiming misrepresentation or fraud. Penalize by penitentiary sentence *only* any default in making reports and misrepresentation of fact.

"The remedy outlined will largely solve the tax problem, County, State, and National. *Then* dependable newspaper and other publicity will be had. Genuine publicity so desirable and necessary for the legitimate advancement of the industry throughout the Mother Lode is greatly handicapped through a fear of the triple alliance of tax collectors. Just why this much mooted question remains on the Lap of the Gods, while there remains so many honest operators and collectors will greatly depend upon how much truth can be generated to bring mining out of the class stipulated by the illustrious Mark Twain: Let's make the light shine and the truth prevail.

"We must not fail to give full consideration to the prospector and prospect mine, the man and enterprise upon which the entire industry rests at the beginning. Every mine was once a prospect. Due to the nerve, foresight and diligence of the former, we owe everything that ultimately results in production and manufacture.

"An improved system of the three-compartment dry rooms for the men at the mines would be welcomed as an inducement to a better class of labor. This refinement would add morale within the organization—lessen dishonesty by eliminating opportunity for it—and honest men will approve. Every man is a leader of industry in his chosen field of endeavor and should be given that consideration to which a white man is entitled.

"It may be well at this time, to indicate to you the object of The American Mining Congress, a national body. I will read from the by-laws of the organization: 'This corporation is formed for the purpose of advancing the mining and metallurgical industries, in all their various branches, within the United States; to assist in bringing about a more perfect cooperation between the Government of the United States and the development of mining and metallurgy; to encourage education in practical and scientific mining and metallurgy; and the dissemination of scientific information in relation to mining and metallurgy and their allied industries; to acquire and disseminate trustworthy information bearing upon the development of the metallic and non-metallic mining resources of the United States; to promote a more cooperative tendency in the evolution of agriculture, mining, manufacturing, transportation and commerce; and for the particular purpose of bringing the mining men of the United States into closer relation with one another, and of promoting a friendly feeling for one another through social intercourse and the discussion of mutual interests.'

"The work of the Congress briefly outlined, permits no activity affecting a division of the industry to be taken up without first placing the matter before the interests concerned. The Washington office acts first as an informant, and then as an agent to carry out the legitimate requirements of the industry. It secures, wherever possible, collective action from groups of producers and States. It places required and convincing unbiased evidence before the Federal Congress. It fills the gap between official and private information, and meets and checkmates incorrect statements from biased sources. It does not 'lobby' for or against legislation. Its work is accomplished by education.

"Many matters of prime importance have been outlined in a series of proposed resolutions which will be presented here today for discussion. Every man should feel free to express his thought. These resolutions cover a wide range of activity and are submitted by way of suggestion, subject to your full determination.

"We are here to organize a California Mother Lode Section of The American Mining Congress, to embrace the counties of Amador, Calaveras, El Dorado, Mariposa, Placer, and Tuolumne, with privileges to adjacent counties later for official recognition, who with all other non-resident interests in these counties are cordially invited to affiliate.

"A Board of Governors consisting of three members from each county of which two will represent the precious and base metal interests, and one the non-metallic and quarrying interests. The member body of this meeting will also elect a Governor and Secretary and

appoint such committees as is deemed advisable to facilitate the work of the organization.

"State divisions of the American Mining Congress although constitutionally a part of the National work, are self-governed bodies, acting independently upon local, County and State matters. Thus this organization should be in position to make clear for the mining industry as a whole its requirements even within the townships of each county."

The following matter received attention either by resolution or discussion:

1.—*Reserving Water:*

That the California Mother Lode Section gives support and endorses strongly proposed legislation which shall provide that in the development of mountain waters for municipalities, 15 percent of the water supply shall be reserved for the use of the miners and farmers in the county where said supply originates.

2.—*Sworn Statements of Operations:*

That the section does strongly support a revision of the California Corporate Security act to require all industrial concerns, where stock has been or is to be sold, to file with the Secretary of State's office a public sworn statement of operations, showing expenditures, incomes and output, every three months, as the most effective way of protecting the investing public.

3.—*Mother Lode Highway:*

That the section devote its energies and legislative efforts to a construction of the Mother Lode Highway as quickly as possible, as said highway will prove a great stimulant to the development of the mineral resources of the Mother Lode counties.

4.—*Resumption of Hydraulic Mining:*

That the section pledge its support to the resumption of hydraulic mining of gold-bearing gravels through the erection, by Governmental aid, of debris impounding dams to retain the tailings on the Bear, Yuba, American and Consumne Rivers, and commends the hydraulic survey now being made by Arthur Jarman for the State Mining Bureau; further, that the section heartily commends California Chapter No. 1 of Grass Valley and Nevada City for its aggressive actions in behalf of hydraulic mining.

5.—*State Mining Department:*

That the section does unqualifiedly pledge its united support of a bill, now being prepared by the State Mining Bureau for introduction before the 1927 State Legislature, to expand the said State Mining Bureau into the State Department of Mines and Mineral Resources, under which department shall be co-ordinated all State functions relating to the mineral industry and which shall give adequate State recognition to the mineral industry.

In the Sierra Nevadas of the Mother Lode Country

6.—*Removal of Prospectors' Bond:*

That the section make every effort to secure the Federal removal of the $1,000 bond now required of prospectors before they can enter upon grazing homesteads or lands for mining purposes.

7.—*Immigration Restrictions:*

That the section urges upon The American Mining Congress at Washington the urgent necessity of legislation to lessen the restrictions upon immigration from Central Europe, so that a supply of efficient mine labor from those countries may again be available.

8.—*New Fuel Survey:*

That the section petitions State Mineralogist Lloyd L. Root to have made a new fuel survey of Northern and Central California, to include coal, oil and natural gas possibilities.

9.—*Use California Materials:*

That the section does hereby heartily endorse the California Development Association's policy that California mineral products be always specified, price, quality and service considered within the State, and does further commend the proposed surveys of non-metallics recommended by the State Mineralogist.

10.—*Relief From Taxation:*

That the section, realizing that the gold miner today suffers from a burden of taxation out of all proportion to his production, does recommend legislation to revise the tax laws of California and to adopt the Utah laws, whereby all mineral tax assessments are placed in the hands of the State Board of Equalization, to insure uniform taxation in all counties.

11.—*Remove Foreign Corporation Tax:*

That the section strongly advocates the removal of the California Foreign Corporation Tax, which is handicapping mining men in interesting outside capital in mine developments.

(*Continued on page* 530)

SHEARING AND BLASTING AS DISCUSSED AT CINCINNATI

One Session Of Cincinnati Meeting Devoted To Four Phases Of The Problems Of Shearing And Blasting, Including "Cutting And Shearing;" "Blasting Coal For Mechanical Loading;" "Results From Cushion Blasting;" "Cutting In Fire Clay Bottoms"

FRANK S. DUNBAR, served as Chairman of the session devoted to Shearing and Blasting, in the place of William L. Affelder, who was unable to attend the meeting. In presenting the subject Mr. Dunbar pointed out that this particular session of the convention was one in which the operating men who put domestic coal on the market are especially interested in, because its purpose was the discussion of practical methods of shooting and blasting and preparing coal for the market with the least number of men and the least expense.

CUTTING AND SHEARING

DR. L. E. YOUNG, General Manager, Union Colliery Co., St. Louis, Mo., presented a paper on "Cutting and Shearing," and called attention to the fact that this paper deals with conditions which have been met in their mines in Southern Illinois, in No. 6 seam, the thickness being 8 to 11 feet. His paper in full, follows:

L. E. Young

"The preparing of working places in a pillar and room mine producing 3,500 to 4,000 tons per eight-hour shift by mechanical loading, involves a number of problems not incident to the operation of a mine producing coal by hand loading only. The Kathleen Mine of the Union Colliery Co., located at Dowell, Ill., is producing practically its entire tonnage by mechanical loading without any substantial change in its system of mining. The coal seam is from eight feet six inches to ten feet six inches in thickness and the usual practice is to leave approximately one and one-half feet of top coal. About 18 inches above the bottom is the blue band consisting of hard shale varying in thickness from one-half to three inches.

System of Mining

"The mine is laid out on a panel system with 10 rooms on each entry making a total of 20 rooms per panel. Rooms are turned on 45-ft. centers and are driven 26 to 28 feet wide depending on conditions. Cross cuts are turned every 60 feet.

Controlling Conditions

"The mine has been operated without any shooting during working hours and only three shots are fired at one time in any working place. A premium is paid on the market for lump coal and usually the 6-in. lump coal will bring at least one dollar a ton more than 2-in. screenings. Under these conditions, obviously, it is very desirable to produce as much lump coal as possible.

Statement of Problems

"Success with loading machines apparently was contingent on proper preparation of coal, that is, the coal must either be rolled out from the solid or loosened sufficiently to permit loading machines to pick it up readily. Elaborate experiments were made with snubbing and it was found that the actual cost of labor for hand snubbing was greater than for the loading operation. Moreover the hand snubbing involved more hazard to the men than any other operation in the mine.

Shearing Machines

"It was decided to try shearing in order to increase the percentage of lump and to prepare the coal better for the mechanical loader. Using one cut in a room this resulted immediately in an increase of about 35 percent in the average tonnage of the loading machines. As the track was being carried on the left side of the room the shearing cut, made by the machine mounted on wheels, was to the left side of the room and it meant that the coal on the right rib was tight unless the coal was snubbed well into the corner or the coal was shot hard. Moreover the task of hand snubbing a room after it has been sheared is dangerous when the coal is laminated as it is in the Kathleen Mine.

"It was then decided to try a shearing machine mounted on caterpillars, with the hope that by using two shearing cuts in each room it would be possible to loosen the coal in both corners of the room and thereby eliminate the digging of tight coal by the loading machines. This type of machine has worked out very satisfactorily except for the fact that with the shearing-bar mounted on the longitudinal axis of the machine, it is impossible to place the shearing-cut flush with the rib. After two shearing-cuts have been made the coal between the cuts will usually settle loose from the roof and the shearing-bar may be caught fast in the cut if the shearing-cut is not made at right angles to the face.

"Experiments were made with two, three, and four shearing-cuts in a 30-ft. room. In practically all instances when three or four cuts were put in the coal settled, and as the coal is more or less laminated, it has been possible to load out the coal mechanically without any shooting whatever. This is not recommended as the loading machine will load more rapidly if the coal has been loosened by a light shot.

"The practice now followed, when the caterpillar type of shearing machine is used, is to place two shearing-cuts in a room, each cut being located about eight feet from the rib. The middle block of coal usually settles and is broken by means of a pop shoot. It is necessary to use two light shots to square each corner. Hand snubbing has been eliminated entirely when the caterpillar type of shearing machines is used.

"The necessity for squaring up the face before making the next cut with the undercutting machine caused the management to consider the feasibility of using a longer shearing-bar as the top coal was not being sheared deep enough when a 7½-ft. undercutting bar was used. A 9-ft. shearing bar was installed solely for the purpose of squaring the face but of course with the attendant result of more coal being produced in each place.

Longer Cutter Bars

"The mine superintendent then suggested using a 9-ft. bar on the undercutting machine as well and this proved successful in producing about 15 tons more per cut per room. About the same time there was an installation of a number of steel pit cars with 1,500 pounds or 20 percent greater capacity than the old style wooden car. The use of larger cars has resulted in a reduction in the amount of time lost by the loading machine in waiting for cars. The cumulative effect of shearing the coal twice, increasing the depth of undercut, and larger pit cars has been gratifying."

Discussion:

S. W. FARNHAM, *Goodman Manufacturing Co.:*

"Some 25 years ago when associated with the Missouri Pacific Railroad properties, long before the advent of mechanical loading in the mines, we were faced with the problem of increasing the lump percentage. We tried shearing. We were mining with the old style press machine. With us, the lump was improved in appearance and size, but the increased percentage of screening produced by the second cutting, coupled with the extra labor of this second cutting, it did not prove successful. Since the advent of the loading machine new impetus has been given the question of shearing in order to get the coal in better condition for the shovel. Dr. Young's paper is extremely interesting because it brings to light this point: that shearing in addition to under-cutting improves the quality of lump coal and improves the capacity in the loading machines to the extent that the extra expense of shearing is justified. One thing that I am quite interested in, is to know what the percentage of lump coal was before and after shearing; that is, producing it with shearing, and producing it without shearing, as well as under-cutting."

MR. JARVIS, *Sullivan Machinery Co.:*

"My experience with shearing coal has been confined to one particular field, that

at Uniontown. The coal there was very much better prepared for hand loading and a loading machine was not used. The hand loading was accomplished after the under-cutting and shearing, and that I think it is fair to assume, would also apply to the machine loading as well. The powder was reduced by at least one-third. The particular gain in this field was in the condition of the top that was left. It was rather difficult to properly arch the top, either after top-cutting or bottom-cutting, but where shearing was introduced it was possible with the two side shots to give a very marked arch to the top which held the top up very much better than was possible to do before in 10, 11 and 12-ft. places and eliminated the use of props. We have different conditions with which to cope than has Dr. Young because the coal does not lay in lateral seams; we have very pronounced butts and face breaks at back and sides. Shearing in the middle gives the proper break when the coal lays in lateral seams."

MR. DAKE, *Joy Machine Co.:*

"In order to carry this on through the different districts I would call attention to the use of shearing machines in the Pennsylvania seam in Northern West Virginia. The chief difficulty was to shoot this seam, which carries heavy bearing in bands, for mechanical loading, although the question of fancy lump, was the minor question of the two. A shearing machine was put into effect, shearing only down the center of each room, the rooms being about 14 feet wide, cutting through the bands, and trying to get away from the former practice of snubbing to get rid of the band, and to make room for the loading machine to get into it. It took several months to straighten out the operation and there was a considerable increase in the tonnage."

DR. YOUNG:

"The question directed by Mr. Farnham as to the percentage of the size I will answer in a little different angle than the way he asked it. Let me say this: we shear coal for the purpose of increasing the capacity of the loading machine. In just a preliminary way, in 185 tons, which averaged one shearing cut, we increased the capacity 35 percent; with two shearing cuts and with better transportation facilities the capacity was 275 tons per shift over a monthly period, so we believe very strongly in shearing.

"In a large mine there is very little opportunity to make screen size tests except by running the stuff through the tipple. Even if you clear the railroad cars and weigh them before and after tests, it is an expensive proposition to make screening tests. So as compared with not shearing, we believe shearing has improved the percentage at least 5 percent on lump. The saving comes largely out of screening."

MR. NELSON:

"Do you find it difficult to remove the impurities from your coal when you are using a shearing machine—that is is it more difficult than when using the bottom cut, and do the impurities average more or less?"

DR. YOUNG:

"I cannot answer that directly. It is a matter of opinion. It is reasonable to expect a substantial increase along the picking tables when making egg and 4-in. lump. In Illinois with the loading machine we pick up very large lumps of coal, so whether the coal seam you have in mind is the same I could not say. After you have sheared a place, you are apt to have the stratum below the blue split, or away from the blue split on to the upper block, or coming down below the top coal. We have a 9 to 12-in. lower laminate, and between that and the blue band we use a pop shot so we will not overcharge the blue band. The blue band then comes out on top, and in loading such big lumps of coal, when the stuff comes out on ton, the fellows in the tipple find the blue band frozen on to one side. Compressed air is used to split off this blue band. In a slab of 100 pounds or even 500 pounds, the blue band is about ½ inch. We would much rather handle the big pieces in the tipple and try to avoid overcharging the blue band."

BLASTING COAL FOR MECHANICAL LOADING

B. L. LUBELSKY, Explosive Engineer, Pittsburgh Coal Co., presented a paper on blasting coal for mechanical loading. His talk was accompanied with various slides showing the effect of the different shots as described in his paper. The cuts were taken in the regular day's work, and were not conditions especially prepared for the occasion. He said the question of lump coal comes up very seriously in mechanical loading, the difficulty being what the effect of the extra holes will have over the previous methods employed by the different mines. He gave the following paper:

"In considering the installation of machines for loading, the cost of production of the coal is of course the important deciding factor. Inasmuch as blasting as an operation affects the cost per ton to a considerable degree, it is essential that it be investigated before, rather than after the change to machines is made.

"A study of blasting for mechanical loading introduces several points of interest that are not met with in hand loading. First, how can the coal be shot so that the machine can load efficiently? Second, what effect will these methods have upon the percentage of fine coal produced, and third, what will the cost of blasting be per ton of coal?

"These questions, covering as they do different methods of working in different beds of coal, can be discussed in a general way only. For the purpose of this paper, the room and pillar method of mining, which is at present the one most largely used, will be considered.

"Mechanical loading involves mechanical drilling of the holes by company men, in addition to the company shooting of the coal. In the average operation in the Fittsburgh Bed, at least two men will be required to do the drilling and shooting for two machines capable of loading a total of approximately 350 tons per day. The drilling is figured on five holes per working place or a total of about 55 holes per shift, drilled, tamped and shot. On the high wage scale the cost per day would be $15.00 or a cost of 4.3 cents per ton. In addition to this drilling and shooting cost, the explosive used will average approximately one pound and two electric blasting caps per 10 tons of coal or roughly a cost of 3.0 cents per ton of coal, making a total cost of 7.3 cents for drilling and shooting. The cost per ton of explosives will of course vary with the physical character of the coal, the width of the working place, and height of the coal, as well as the face preparation. Where the coal is center sheared, the tonnage per pound will be materially increased. In one Illinois mine, where double shearing is being used, 15 tons per pound of explosive is being obtained as against only five tons where the coal is only center sheared.

BLASTING

"The essential difference in shooting for mechanical loading as contrasted to shooting for hand loading is that in the latter case lump coal is of primary interest since the loading efficiency of the individual miner is not of great importance in the cost of the coal. When shooting for mechanical loading, the machine efficiency is the more important factor, with lump coal as the secondary consideration. A cut in order to allow for efficient loading mechanically must be so broken that there is some loose coal for the machine to start on, that the coal is cut free from the ribs and top, and that the lines of breakage are so distributed that the coal will not be set down in a solid block across the width of the room.

"The indirect cost of blasting, due to improper shooting, is by far the greatest cost traceable to this operation. It has been generally agreed upon by men investigating the subject, that the success of mechanical loading depends largely upon proper preparation of the coal at the face so that the machine can operate at its greatest efficiency all the time that cars are in place.

"Time study analyses of loading machine operations compiled by Messrs. Gray and Clark of the Pittsburgh Coal Co., show the interesting fact that in the cycle of operations incidental to loading coal mechanically, cars are in place at the face only about 60 percent of the time during a full working shift. This means that of the 480 minutes per working shift, the machine can devote a maximum of only 300 minutes to actual loading of the coal. In order to obtain a high degree of efficiency during the 60 percent possible loading time, the machine should load without being hindered by coal improperly shot.

"To a large extent a previous knowledge of the shooting of the coal with a view towards mechanical loading is desirable before purchasing a machine, since the type of machine used may be influenced by the way in which the coal reacts to shooting. In certain beds of coal as the Pittsburgh Bed, the coal has a decided tendency to set down on the cut in almost a solid block and a machine to be successful must not only be able to load out coal that is shot down or loose, but must have enough digging power to load out the bottom coal that settles down, although it is more or less fractured by the shots. Other beds of coal are of such a friable nature that shooting rolls almost the entire cut into the room and allows for ready loading without the need of digging power.

"Although blasting for mechanical loading has introduced certain problems peculiarly its own, there are certain factors that have been thoroughly discussed in connection with blasting for hand loading that are common also to this new problem. The care in undercutting must not be neglected. Straight ribs should be cut as far as practicable with the type of machine being used.

Also it is essential that the cuts be made directly on the face in those beds of coal having a pronounced cleatage. Too often one side of the room is from one to two feet ahead of the other side, making the face advance at an angle to the cleat. The 'Bug dust' must be scraped out from under the cut for the best results. A normal kerf of six inches is none too large a margin of expansion for the breakage of coal and an inch or two of bug dust at the back of the cut materially decreases the efficiency of the undercut. Drilling of boreholes should not be done before cutting, as this results in getting holes longer or shorter than the cut, or placed too close to the ribs. If it is necessary for the best cycle of operations, the holes should be measured before shooting and if not correct should be changed to conform to the regular system in use.

"The most important new question the underground man has to decide in shooting for mechanical loading is the actual distribution of the explosive over the cut of coal in order to have the coal shot with a minimum of overhang on the ribs or face, and without having the coal set down in a solid block that cannot be attacked readily by the machine. In the final analysis this brings up the questions 'how many holes are needed, where shall the holes be placed, and how much explosive is needed in each hole.'

"In changing over from hand to mechanical loading, the natural tendency has been to adhere as closely as possible to the blasting methods that had been in practice. If the regular charges of explosive did not bring the coal for easy machine loading, the general belief has been that more explosive would be the cure. This has resulted in considerable overshooting of the coal as a means toward easier loading for the machine.

"Unfortunately overshooting produces excessive fine coal without accomplishing the results necessary for good loading. Generally a shot has a normal zone of breakage determined by the texture of the coal. As an example of this Figure 1 shows the normal breakage of a tight shot in a mine of the Pittsburgh Bed. Irrespective of the amount of explosive used, this zone of breakage remains almost constant. Over-charging of the holes results in opening these breakage lines to a greater extent without increasing the zone of the shot. A hole properly placed requires a certain charge of explosive to break the coal within the normal range of that hole. Any additional explosive causes excessive breakage without increasing the ease of mining. *If a normal charge in each hole does not succeed in bringing the entire cut, the cure will be found in varying the number and placement of the drill holes.* Less explosives in each hole and more holes is the solution of the blasting problem. This will eliminate overhang and prevent the coal from being set down in a solid block. This means a greater drilling cost, but the expense of drilling an additional hole is slight in comparison to the reduction of loading efficiency and lump coal production, resulting from poor blasting practices.

"In the Pittsburgh Bed, it has been almost general practice to shoot two holes per cut of coal. The tight shot is fired first and the miner shears through to the back of the cut. All the loose coal is loaded out before the second shot is fired. The butt shot is then open ended and gives the greatest blasting efficiency and the best grade of coal.

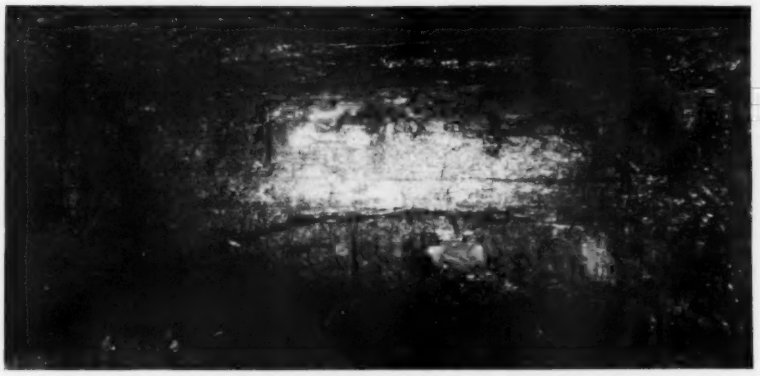

Fig. 1, *Mr. Lubelsky's Paper.—A typical tight shot in one section of the Pittsburgh Bed. Shot with three cartridges of permissible explosive. Showing normal zone of breakage*

Fig. 2, *Mr. Lubelsky's Paper.—After firing the second shot, with two cartridges. This cut could not be loaded efficiently with a machine. The coal is too solid from top to bottom and across the room*

Fig. 3, *Mr. Lubelsky's Paper.—Tight shot under same conditions as Fig.* 1. *Overcharged in order to show effect of overshooting. This was shot with four cartridges in place of the usual three. Very little added breaks in the body of the coal as a result of this. Note the shattering around the borehole*

"Figure 1 shows the results generally obtained with a tight shot in one mine, using three cartridges of a permissible explosive. The coal is well cut from the back, ribs and top, but has set down in an almost solid block. The miner will require a considerable amount of pick work, cutting in along the powder crack until the block is loosened, and then the coal will be relieved. But for the entire tight shot, there will be constant use of the pick in order to loosen the coal and break through the bands.

"This method of shooting has been found to give the most satisfactory results from the standpoint of lump coal in spite of the fact that the miner is constantly required to use his pick, in loading out the tight shot. The state-

Fig. 4, Mr. Lubelsky's Paper.—After firing the second shot of Fig. 3, with three cartridges instead of the usual two. The entire cut was shot with seven cartridges instead of five and compares unfavorably with the coal shot in Fig. 2

Fig. 5, Mr. Lubelsky's Paper.—Two bottom shots, drilled 6 feet from the ribs, 3 feet deep, between the bands. One-half cartridge was used in each hole. The purpose of these shots was to break the bands and loosen the bottom coal so the machine could have an entrance into the cut of coal

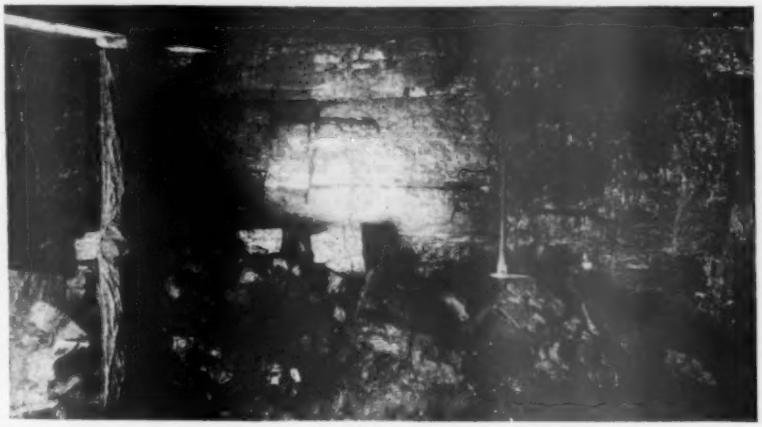

Fig. 6, Mr. Lubelsky's Paper.—Center shot, fired with 2.5 cartridges, to prevent the entire cut from setting down in a solid block across the room

ment that pick work makes for more slack is not applicable to this type of shot, for the reason that his pick work is done along the rib which has already been powder cracked.

"In shooting this same cut of coal for mechanical loading it is considered impracticable to shoot only one part of the cut at a time, and for that reason if the same system of shooting were to be used, the two holes would be fired together. Figure 2 shows the result of a typical cut of coal in the Pittsburgh Bed, high coal, fired with the same average charge as those shown before, i. e., three sticks in the tight shot and two in the butt shot. Although the coal could be loaded out quite easily by hand, always resorting to the use of the pick, a machine starting to load such a cut would encounter an almost solid block of coal. The coal has been dropped from a natural bedding place about 12 inches below the draw slate in almost a solid block that would allow the machine no opportunity of loosening the coal.

"The effect of overcharging the boreholes is shown quite clearly in Figures 3 and 4. In Figure 6 the tight shot was fired with 4.0 cartridges instead of the usual three. All other conditions were practically constant. The zone of breakage was practically the same as in the previous shot, the only noticeable difference being that a greater hole was blown out along the top. The excessive fine coal caused by overcharging can be seen around the borehole. The butt shot in this cut was also overcharged, being fired with 3.0 instead of 2.0 cartridges. Comparing this cut as shown in Figure 4 with that of the previous cut shown in Figure 2, it is very evident that shooting with more than a normal amount of explosive in the same number of bore holes does not break the coal to make for easier mechanical loading.

"These cuts show quite clearly that the type of shot that can be loaded out by the miner with comparative ease are entirely unsuited for mechanical loading and that some other system of shooting must be resorted to. In this particular case there are several points to bear in mind. The coal in the Pittsburgh Bed is fairly uniform in texture from top to bottom. The cleat is very well defined on the face and on the butt. The natural break of the coal is to drop from a parting near the top of the coal, shearing very well from the rib and the face. The major difficulties encountered are in the bands, which must be broken for efficient loading and in the fact that the coal tends to set down in a solid block across the entire face.

"In order to overcome these difficulties, the seven cartridges should be divided up into five holes. Two bottom or snubbing holes are intended to break the bands and so loosen the bottom coal that a machine could dig into and load out the bottoms, thus releasing the top coal and allowing it to roll forward if properly broken. The break shot should be fired in the center rather than on the rib in order to prevent the possibility of the entire cut setting down across the room. The two corner shots are intended to clear the ribs. After the last shot had been fired in a test cut there was approximately 14 tons of coal ready to be loaded before reaching any standing coal, and as this loose coal was loaded out, the remainder of the coal gradually rolled out, so that there was no coal standing in place. Figure 5 shows the line of break followed by the bottom shots. Figure 6 shows the results of the center shot. This shot broke the coal sufficiently so that a machine could dig its way through to the back if necessary. Figure 7 shows the results of the first butt shot. The shear along the rib was an excellent one and the coal was brought free from the top. Figure 8 shows the last shot which caused the front face of the coal to roll forward.

"The advantage of the extra holes using the same total quantity of explosive is very clearly shown by these illustrations. Although this placement of drill holes will meet the demands of certain sections, it is not to be taken as a recommendation for all conditions. In some sections of the same bed of coal where top coal is left in place for roof protection, it is necessary to add another top hole in order to assure a clean break along the top. In other sections or other beds, the bottom coal may require an additional hole in order to break it sufficiently to allow the machine to enter. But at all times, where additional breakage is required, it should be obtained by the aid of an extra hole placed in that section of the coal remaining unbroken rather than by an attempt to overshoot the regular holes.

"A consideration of the comparative production of lump coal for hand and mechanical loading requires a knowledge of the previous methods employed with hand loading. In all mines in which the practice has been to shoot the entire cut of coal at one time, it is hardly to be supposed that the introduction of the extra holes will cause a greater percentage of fine coal, providing the proper supervision is given to the drilling and shooting. However, each added hole introduces the possibility of misplacement and overcharging that must be contended with. In mines following the practice previously described for the Pittsburgh district, consisting of shooting the 'tight shot' and shearing to the back before firing the 'butt' shot, the comparison of lump coal production is unfavorable to mechanical loading. In research work conducted in cooperation with Carnegie Institute of Technology, Bureau of Mines, and the operators of Pennsylvania, a series of tests was conducted at the Banning No. 2 Mine of the Pittsburgh Coal Co. Incidental to the tests, the lump coal percentages were determined separately for the tight and the butt shots. Although these tests covered a wide range of factors influencing lump coal production, the relation between the fine coal obtained from the tight and butt shots was fairly uniform throughout the entire investigation.

"An analysis of these results published as Bulletin 19 of Carnegie Institute of Technology helps to prove the importance of open ended shots as a means towards obtaining the maximum percentage of lump coal. For the entire year's run the average lump coal produced from the tight shots was 5.2 percent less than that produced in the butt shot. This varied from 2.2 percent in some tests to 10.4 percent in others and the greatest difference was found in those tests giving the best general results.

"The reason for this is self evident. The tight shot has no room for expansion except the kerf of the undercut which is insufficient for expansion without crushing. The butt shot has the additional open end and can expand without crushing. Even an overcharge of explosive in an open ended shot is not so readily felt in the slack percentage since there is room for expansion without undue breakage except around the borehole.

"With these figures as a basis it is natural to suppose that by shooting the entire cut of coal at once the slack percentage will increase from 3 to 5 per-

Fig. 7, Mr. Lubelsky's Paper.—First rib shot fired with 1.5 cartridges

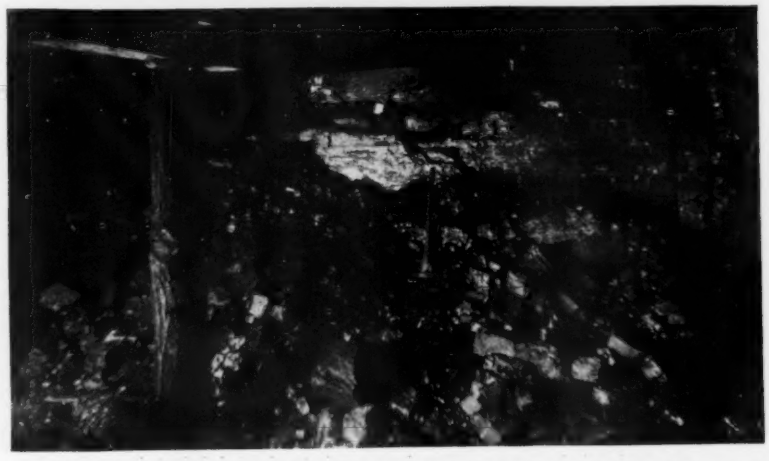

Fig. 8, Mr. Lubelsky's Paper.—Second rib shot fired with 1.5 cartridges. As a result of 6.5 cartridges placed as shown in the figures, there was about 14 tons of coal down so that the machine could start loading. The remainder of the coal rolled forward as rapidly as the loose coal was removed

cent over what had been obtained in the mine previously. At the differential in selling price between lump and slack coal, the cost of additional slack presents a figure that cannot be neglected."

***DAVID INGLE**, Oakland City, Ind.:*

"We have been loading coal mechanically for three or four years now. I think about the first thing we ran up against when we first started mechanical loading was the difficulty in getting the coal down so that it could be loaded, without too much hard work on the part of the machine. We are still having that trouble though not nearly as much as we did at the start. In the mines where we have loading machines, before we began loading mechanically, with hand mining, we shot two holes to the room, the rooms being 21 feet to 27 feet and averaging around 24 feet. We didn't pay a great deal of attention to the powder the miner used, and if we told him how to do it, he didn't pay any attention, and used it as he saw fit. Since loading the coal mechanically all that has changed. The first thing we tried to do was to put in the third shot. We have found with under-cutting machines the tendency always of under-cutting is to turn the cut out a little at both ends, which results in the coal naturally breaking down just as cut out and the corner holes had to be drilled. The same way when the holes were drilled parallel with the side walls, the holes would be out just a little bit, and it took us quite a while to learn to have the holes point out in the same direction—when these holes pointed out it caused the coal to break down improperly, and with tight corners. We still have some tight corners but only one occasionally and for a long time we didn't have anything else. When you drill the holes parallel with the side walls of the room you get away from tight corners. We found in some instances that a good deal of trouble was caused by the holes not being drilled deep enough, particularly for hand used electric drills, because they are broken down a great deal of the time. We have had less success with electric drills than with all other machinery. When you drill by hand you have to watch to drill deep enough, particularly when you find something hard to drill through. We tried shooting three holes, shooting them in rotation, first the left hand, then the middle and then the right. We tried the middle first, then the left and then the right. We tried all three at the same time, and I do not know that we know exactly how

Fig. 1, *Mr. Nelson's Paper.—After a tight shot. Test* 1

Fig. 2, *Mr. Nelson's Paper.—After a tight shot. Test* 5

to shoot coal after three years' time. We have made some progress, have less, but still some, tight coal. Some of the tight coal is due to the tamping not being done properly—either not tight enough, or we do not get the explosive back far enough in the hole. The farther back the greater the results.

"We have tried a little cushion shooting and I don't know whether it helped much or not. As Mr. Young has said, we cannot very well tell when we do try the different shots, what percentage of screening has resulted, for the reason there is no way of testing out its run, as to how much lump coal and how much screenings.

"We did do some snubbing and some shearing a couple of years ago but at that time we were running the loading machine, the cutting machine, and the locomotives both day and night, so we had to set the shearing machine on the side tracks much of the time. We had very good results with shearing. It increased the percentage of lump some and we were favorably impressed, but we abandoned it as we were more interested in trying to run the mine day and night than trying to get a larger percentage of lump coal. Personally I believe in shearing, and think it must be a tremendous help in loading coal mechanically and we probably will go back again, but not at this time. We are trying the different sizes, different powders, different placements of holes, and really haven't arrived at conclusions worth telling about at this time. We have learned that to make progress you cannot fight the coal machines—we must have machines to produce the coal that we are now paying labor for doing. We are doing this to a great extent but there is still a whole lot to learn."

RESULTS FROM CUSHIONED BLASTING

C. W. NELSON, Explosives Engineer, Hillman Coal & Coke Co., Pittsburgh:

"During the last two years much has been said and written in favor of and against the method of blasting known as 'Cushioned Blasting' or 'Air-Spacing.' It would seem that the different writers have praised or condemned the general method on no other grounds except that it proved successful or unsuccessful when used under the conditions prevailing in their mines. They have not seemed to take into consideration the fact that under different conditions the method might produce different results.

"The average operator is interested in one or both of two things: a maximum quantity of coal loosened per pound of explosive used, or a maximum percentage of lump coal per ton of coal loosened. Every operator is, therefore, vitally interested in proper blasting methods.

"The results to be obtained from cushioned blasting are, necessarily, dependent upon the physical characteristics of the seam of coal in which the method is tried. If the physical characteristics are such as to permit its successful use, then the results will show the benefit derived from this method.

"Before one decides whether the method is adaptable to his conditions, it is necessary that he know what cushioned blasting is and why it is successful under certain conditions. Cushioned blasting or air-spacing is the method of charging and tamping holes so as to leave a portion of the hole between the explosives charge and the stemming, void of either explosives or stemming material. Leaving this void between the explosives and the stemming, lengthens that portion of the drill hole in which the expanding gases, generated by the discharge of the explosives, can exert their force.

"It has been found that in most machine cut coal, the resistance from the back of the drill hole to the machine cut and to the front of the cut are not the same. If the resistance offered in these two directions were the same, then the proper location for the explosives charge would be as near the back of the hole as possible. A charge so located would have a balanced burden to move. However, it has been found that, except in very high coal, the resistance is usually greater toward the front of the cut. In order to balance the burden upon the explosive charge it is necessary to have the explosive charge so located or distributed in the hole as to make the burden in both directions as nearly equal as possible.

"To show that the length of charge is an important factor in the production of lump coal, your attention is called to an investigation conducted in 1923-24 under the direction of the Carnegie Institute of Technology and the United States Bureau of Mines. Among other tests, four were made, one using 1¼ by 8-in. cartridges of a certain permissible explosive, and three using 1 by 8-in. cartridges of the same mixing of the same explosive. All of these tests were carried on in the same room. The placement of holes was the same in all four tests. With the 1¼ by 8-in. cartridges it was necessary to use 32 to 34 inches of explosive for the opening shots and from 20 to 24 inches for the remaining shoulders. This test yielded 64.2 percent lump coal over a 1¼-in. screen. In the second test the same weight of explosive as in the first test, but in 1 by 8-in. cartridges, was used. This gave a length of charge of from 48 to 50 inches of explosive for the opening shots; 68.4 percent of lump coal was

obtained in this test. In the third test 40 inches of explosive in 1 by 8-in. cartridges was used in the opening shots. 68.5 percent plus 1¼-in. lump coal was obtained in this test. In the fourth test 36 inches of 1 by 8-in. cartridges was used and 69.1 percent lump coal was obtained.

"The following is a table showing the number of tons of coal loosened per pound of explosive used in the different tests:

Test	Tons of coal
1	12.4
2	13.0
3	16.8
4	18.3

"In the first and fourth tests we were satisfied that minimum charges were being used. The increase in lump coal, from 64.2 percent to 69.1 percent, an increase of 4.9 percent, was due to our being able to reduce the quantity of explosive used, by finding the length of charge necessary to give a balanced shot.

"Later a test was conducted, using air-spacing and 1¼ by 8 in. cartridges of explosive. In this test the average combined length of the explosive charge and air-space was 42 inches. Instead of it being necessary to use from 32 to 34 inches of explosives, as in the first test, the charges were reduced to from 20 to 24 inches of explosives for the opening shots. With this method 69.6 percent plus 1¼-in. lump coal was produced and 17.25 tons of coal were blasted per pound of explosive used. All of these results were obtained under actual mining conditions in an operating mine.

"About six months later I was sent to a mine to try to increase the percentage of lump coal at that plant. At the time of my first visit to this plant, they were using 1½ by 8-in. cartridges. In order to loosen the coal in the opening shot it was necessary to use close to the permissible limit of 1½ pounds of explosive. A number of observations were made and the size of the cartridges was reduced to 1¼ by 8 inches. With this reduction in the size of the cartridges it was found possible to reduce the weight of explosive used per charge and to increase the large sizes of coal obtained. Not being fully satisfied with this reduction the size of the cartridges was reduced to 1⅛ by 8 inches, and it was found that, except under abnormal conditions, the cuts were blasted with the same number of these cartridges as with the 1¼ by 8-in. cartridges.

"This discussion of the effect of the length of charge upon the production of large sized coal, or the use of a minimum quantity of explosive has a direct bearing upon the use of cushioned blasting. Quite often it is found that the permissible best suited for use in a certain mine is neither bulky nor suited for use in the smaller diameters. Yet in order to produce a marketable product it may be desirable to allow the gases to exert their force along a considerable portion of the drill hole. The only alternative is the use of cushioned blasting or a modification of this method.

"To find the proper length of air cushion to give a balanced shot, I know of no way except by cutting and trying. Increasing the air-space in about 3-inch stages, one should observe what the total length of explosive and air-space is when the breaking down shots begin to 'hang' at the back of the cut. When this length is found, reduce it until the shots do not 'hang' at the back. This total length will be found to be the length necessary to give a balanced shot. This length will vary in different seams and to a small degree in different parts of the same seam. Its length will be dependent upon the height of the holes above the cut, the depth of hole and depth of cut, the direction and character of the cleats and other weakness planes, and the number and resistance of the bands and other impurities in the coal.

"Cushioned blasting will be found to be advantageous in low coal where the depth of cut is such as to cause the front of the cut to 'hang' after blasting. Mr. German and others have used the cushioned method in the low coals of West Virginia with considerable success.

"The method has not been found to be successful when advancing on the butts of the coal in high seams. This is due to the vertical weakness planes running parallel to the direction of the drill holes, thus allowing the line of least resistance to be toward the front of the cut. Under this condition the charge should be kept toward the back of the hole, in order to allow the force of the explosive to spread along the back of the cut as much as possible.

"There are three common methods of obtaining the results of cushioned blasting. They are; the use of smaller diametered cartridges of explosive, the use of rock dust stemming, and the use of a pure air cushion obtained with some type of air-spacer.

"The use of the smaller diametered cartridges has certain advantages and disadvantages. In certain states, the mining law does not permit the use of cushioned blasting in its true form. In these states it is necessary to use some modified form. The use of the smaller diameters more nearly meets the requirements than any other modification that has been tried. It allows the shot-firer to obtain very nearly the proper length of charge without over-charging,

Fig. 3, Mr. Nelson's Paper.—After a tight shot. Test 6

Fig. 4, Mr. Nelson's Paper.—After a tight shot. Test 7

Fig. 5, Mr. Nelson's Paper—After a tight shot. Test 8

and permits him to tamp the hole solidly from the explosives charge to the mouth of the hole. However, as has already been stated, it is often true that the explosive best suited for a certain coal is not fitted for use in the smaller sizes. The explosive makers, also object to the use of the smaller sizes, claiming that as the diameter of a cartridge is decreased the rate of deterioration is increased. This is true and must be considered before deciding upon the use of a certain small diametered cartridge.

"Rock dust stemming has been given considerable publicity as a substitute for true cushioned blasting. At best, rock dust stemming can only be considered as a make-shift substitute for cushioned blasting. Its action as cushion depends upon its compressability and porous nature. The cushioning results of rock dust also depend upon the density or firmness with which the rock dust cartridges are loaded, and upon the care with which the shot-firer charges and tamps the hole. Both of these are variables and consequently the results obtained will vary directly with them. Inside storage and dryness of the rock dust must also be considered when using this method.

"Wherever it can be used, true air-cushioning is the best method. Its principal advantages are that it allows a uniform length of charge and reduces the human element to a minimum. With this method the proper length of combined charge and air cushion are accurately determined and allowances are made for variations in the characteristics of the seam. This having been done, the length of air cushion is decided upon and the air-spacers are made this length. The shot-firer has nothing to do but insert the charge and air-spacer into the hole and tamp the rest of the hole solidly from the end of the spacer to the collar of the hole. This method also allows the use of any sized cartridge of explosive which is found desirable.

"It is often found the abnormal conditions prevail in certain sections of a mine. This method of cushioning permits its selective use under these conditions.

"It must be remembered that cushioned blasting, or any of its substitutes, is not a cure-all for blasting coal. Your conditions may be such as to prohibit the use of this method. There is but one way to determine this. It must be tried and observations made at the face to learn whether the method gives the miner good shots or not. This having been done, there is but one way to learn whether the method is producing more lump coal or not, and that is to keep an accurate check of the percentage of the coal passing over the screens at the tipple and checking this against the percentage obtained under former methods. These two things are essential in determining the advantages and disadvantages of any method of blasting. The determination of the amount of lump coal produced can not be learned by observing the results of a number of shots in the mine, but must be the result of actual measurement."

Fig. 6, Mr. Nelson's Paper.—Spacer used for air-spacing in blasting

***JOHN C. BART**, Union Collieries Co.:*

"We have derived some benefit by loading coal with machines, but we discovered we could not load coal with a machine until we had the coal shot down in a way that the machines could load it. The machine simply was never where we wanted to load the coal. When we started in shooting coal we met with certain difficulties.

"We drill the first two holes on the rib, 45 degrees down, until we overlap the center line of the cut. We take a half stick of powder, place it half way between the base length of our hole, and allow nothing but air in the back of the hole. We fire two side shots, blow out, then do the snubbing. We drill the next two holes just as parallel as possible with the first, leaving an overlap in the cut at the distance of from 6 to 8 inches, or even 10 inches won't hurt; place our shot of powder in the middle of that hole half the distance back, then fire.

We drill nine holes, and shoot right beneath the binder. For the first shot we drill a hole overlapping our cut, placing the powder. Let me say that this takes less powder than if you place the powder in the back of the hole, with the hole drilled the same depth. We bring the powder forward, drill a hole about 6 feet 8 inches over the cut, bring the air gap half the distance, which will vary according to the vein of coal you are in. If the amount of powder does not bring you to the front, we move the powder forward. We swing that, and then put two pop shots in, still overlapping cut, which will leave the coal with a 5-in. kerf and have about 4 inches from the binder to the top of your coal. That reduces the slack practically 8 percent. While we do not average our coal by actual measurements when loading at cut, the stock is run at the tipple on a ¾-in. screen.

"We drill three holes above the binder, take a pop shot the same way, half the distance back, loosen the binder, drop two side shots, drop the binder, then do the same to the top. It doesn't take so much effort and can be done with a smaller amount of powder. It takes nine holes for a room, you use less powder and you gain 8 to 10 percent on screen coal. All of our shots have an 8-in. tamping of clay on the land part of the hole—first the clay then the cartridge held with a wire and set up to it.

"They may tell you it is unlawful but I am going to tell you it has never failed to move the clay. If we are shooting unlawfully what do we do to the powder that it gives us a better grade of coal, using less powder? If it is unlawful to shoot that way in your state, make the powder men analyze the matter and see what we do to his powder to increase the efficiency of it."

MR. DUNBAR:

"The seam of coal Mr. Bart is talking about is at Freeport and has a very hard binder of dirt—the center coal is more than 30 inches from the floor, and his method is to shoot down the lower band, get that first, and then shoot the upper. The trouble with putting in the ordinary type of shot on a rib of 18 inches is that if you put in enough powder you will injure the roof, the condition of which is not any too good. Therefore, he has worked out this scheme and has carried it on successfully. It may not work so well with someone else—the only thing to do is to try it."

CUTTING IN FIRE CLAY BOTTOMS

***W. J. FREEMAN**, Fayette Realty & Development Co.:*

"When I was asked to give a talk on 'Cutting Coal in the Bottom,' I thought it something of a joke and refused on the grounds that there was nothing to talk about a thing so simple; that we are just doing it in the ordinary way that a cutting machine is operated, and that that was all there was to it. However, Mr. Shirkie insisted even to the point of intimating that this meeting would be something of a failure if it did not have this, so not wishing such a calamity, I told him I would do the best I could. However, to put in 15 minutes I would have to have something of the gift of the college professor who it is said could draw a straight line on the black board and talk to his class 30 minutes about it, and then draw a line across it and talk another 30 minutes about that line.

"All I can say is in a very few words that at our Fayette mine we are working the Indiana No. 5 vein of coal, which lies over the No. 4 vein, which we have entirely extracted.

"On account of this extraction we never attached any sure value to operating No. 5 vein, and considered that if we did have successful operation that it would be a clean pick up. We of course had no means of knowing whether or not the extraction of No. 4, 100 feet below No. 5 damaged the working conditions of No. 5.

"We started developing No. 5 some little time before finishing No. 4, so that the No. 4 production helped the developing expense of No. 5. The first question in starting No. 5 was whether cutting machines could be used. Up to that time no one had succeeded in undercutting in the coal in this vein in this particular field on account of the sulphur balls in the bottom of the coal, and so far as known, no one had made any extensive try of cutting in the clay underlying the coal.

"We started from the shaft bottom cutting in the clay after seeing that our conditions were the same as those elsewhere as to sulphur balls.

"We have continued to do so ever since, and I think have fully demonstrated that our venture has been well taken. We are loading the coal with Joy machines and have six now installed with results that seem to justify us in placing in more to the extent of loading the capacity of present development or about 1,000 tons per day. We have to use the smallest type of Joy machines on account of heighth of coal, four feet eight inches. Had we five or six inches additional heighth we could use the large size of loaders and get much better results. As to working conditions in the coal on account of removing the lower vein before mentioned, will say that there has been found some detriment, but nothing prohibitive. Now as to cutting in the bottom as said in the beginning there is very little to say. We use Sullivan machines, and as the cutting conditions vary in the different places there is no regularity as to bit changes. On the whole the cutting is harder than in No. 4, but how much harder it is impossible to say. Some places, no changes of bits are made, some places they are spotted, and others have to be changed entirely. The worst drawback is the throwing back and handling the cuttings, and the very great amount of dust made in cutting. The throwing back and handling the cuttings are expensive and the dust uncomfortable to the machine runners, some of whom use respirators. This dust of course makes for a safe condition of the mine as it is virtually rock dusted.

"As to expense of throwing back and handling, it is impossible to separate it as the 'muckers' do other work, such as tracklaying and timbering.

"Now as I have not used fifteen minutes, at the risk of being called down by the Chairman, I am going to talk about another kind of coal cutting. I think I will stay within my subject as my subject is "Cutting Coal."

"There is a place where coal is cut not only at the bottom but at the top, at the sides and in the middle. I refer to the selling end of the business. The selling end is the crime of the coal business. If as much brains and effort were put in the marketing as on the production end of coal, and as much as in the marketing of other commodities there would be a different story to the business.

"Some have spent large amounts in installation of loading machines, and others are on the verge of doing the same, all for the pleasure of passing the reduced cost of mining the coal if any, over to the consumer.

"Investment, energy, ability, and close attention is expended in the production of coal, which is then marketed by main strength and awkwardness. This is not so in any other commodity marketed in the country. If you put in a new mine, when you build your tipple, if of wood, you pay the same price for timber of the same grade, shop as much as you will. If of steel, still the same price on all quotations. When you buy cement, same old price everywhere. Steel siding, same price. Wire rope, no difference. Steel rails, try to buy cheaper. Mining machines, any difference? Motor, ever get any bargain prices? Copper wire, just the same. Now some one just mention a commodity that is foot-balled in the market like coal is. When you go into a store to buy a neck tie, the price is so much and you can take or leave it. If you go into the next store the price is the same for the same grade of tie, take it or leave it, for the reason that the proprietor holds it for a profit over and above what it costs him. He wants to sell just as bad as the coal operator wants to sell his coal, but he has nerve enough to pass the sale up unless he gets a profit. Not so with the coal operator when he is asked for a price; he of course asks a price that will net a profit, and it is surprising how small a profit seems to look good. If the buyer won't pay this price, however, the operator for the joy and pleasure of running his mines will take cost, and in fact below cost. I should not have said pleasure of running his mines, Mr. Chairman, for he is not happy in running at a loss. Neither is he "crazy in the head" enough to think he can keep on forever at a loss. What he has in mind is 'doggone you buyer, you can get away with murder now, but just you wait till that strike scare or that strike comes off next spring, then what I will do to you will be a plenty.' Or he will think: 'You can make me sell coal at a loss now to keep going, but I will get "mine" next winter, as the squirrels say it will be a hard winter and 20 below zero will mean $5 domestic coal.'

"The crime of the present marketing of coal is that public utilities and railroads, the largest consumers buy their coal on the average at less than the cost of production, while the poor devil in the middle of winter in ton lots pays enormous prices, and in basket lots fantastic prices. It is all the fault of the coal operator that utilities do not pay fair prices, as their rates are based on their costs and coal is the large end of their costs.

"Railroads are willing to pay fair prices, as it is to their interests to have their operators prosperous. However, a purchasing agent can not pay any operator more than some other operator is offering him coal at. If he is paying one a fair price and another comes and offers to cut the price, the purchaser is bound to take the lower offer, or let the first seller meet it, otherwise he would not seem to be doing his job justice. Likewise, if in one railroad district the operators are receiving a fair price as a whole, and the road is getting coal at a lower price in another district, the fair priced purchasing agent is subject to criticism, if he does not buy as favorable as the other district purchasing agent.

"So what is the use of worrying over cheaper production by a few cents, or lower freight rates we think are needed, when every one here knows that anything gained in this way is invariably passed on to the buyer. As I see it unless we market our coal with some of the intelligence that prevails in other industries, we will continue to have grief in the coal business. We are mining plenty of coal in this country and it would be a stable business if it could be marketed at a profit."

***JOHN L. CLARKSON**, Clarkson Coal Mining Co.:*

"At the present time there are a number of low vein operations throughout the country working with the conveyor system or a scraper type loader that have adopted the system of cutting the fire clay or bony from beneath the coal in order to give the coal a loose end for blasting purposes. The low vein operator has probably conceived the idea and has adopted the plan for the reason that the machine cuttings added to the breakage of the coal was making for him a very high percentage of screenings. By cutting out the clay bottoms instead of the coal, he is able to reduce and eliminate the bug dust and reduce the percentage of screenings.

"If the plan of cutting the clay is profitable for the low vein operator, why should it not work as well for the high vein? The loading machine question has brought us many new problems and I believe the cutting of the clay bottoms is one of our new questions.

The cutting of the clay bottoms decreases screenings. It eliminates cutting hard sulphur boulders that usually lay in the bottom of the coal. It cuts the clay clear from the coal and saves coal that is quite often thrown back into the gob pile.

"In some of the mines over the country they have adopted a plan of spraying the cutter bar and bits in order to keep the coal dust down. By cutting the clay bottoms, one would eliminate this arrangement as the supplying of water to each cutting machine necessarily runs into money.

"In order to be successful in cutting the clay, one must consult the manufacturer of the cutting machine and obtain

his recommendation on a special chain for cutting clay. One will not have great success cutting clay by using the same chain as used for cutting coal.

"At our mine in Nashville, Ill., we are cutting a bony clay band about 24 inches from the floor. The machine we are using is built similar in all respects to a short wall machine. The cutter bar is on top of the machine instead of on the bottom. Our first seam is fairly regular and we have no trouble whatever in keeping the machine in the dirt band. We had considerable trouble at first in finding the proper cutter chain to cut the band, as the band was much harder and tougher than the coal, but after trying various chains and lacings we finally decided to use the Sullivan 11 position chain, where each lug has two bits. This chain cuts the clay and boney quite satisfactorily and our men are able to cut as many places per day in the dirt band as they formerly cut in the coal. Our screenings have been decreased from 10 percent to 12 percent. We get cleaner coal at the face and the results are very satisfactory. It has taken us over a year to accomplish our problem, but we feel that the money spent on the experiment has been well spent.

"The adoption of the loading machine made us seek some new method of cleaning our coal. The cutting of the dirt band is our first step and we have found from actual performance that the cutting of the band has almost entirely eliminated our dirt trouble.

"The new system adopted has given us the following results:

"1. Decreased our ¾-in. screenings from 22 percent down to 12½ percent.

"2. Decreased our dirt refuse taken out by the washer 50 percent.

"3. Increased our lump coal to 75 percent—2-in. lump.

"4. Increased the amount of coal from blasing with powder. Formerly we obtained 85 to 90 tons per 25 lb. keg of powder; we are now receiving 115 to 120 tons per keg of powder.

"Time and money is well spent at the face of the coal seeking some method to cut bands or clay bottoms, for you decrease the percentage of screenings, eliminate cost of hauling dirt to the surface, leaving the waste matter in the mine where it properly belongs."

Discussion:

MR. MARVIN:

"Mr. Nelson said in his paper on cushion blasting that one of the three ways was to use a cartridge of smaller diameter. As pointed out by the Bureau of Mines, if you are using a cartridge 1¼" and want to reduce down to 1", you pay money for more paper and less explosive. Not only that, you decrease the sensitiveness of your powder by using the smaller diameter, and when you reduce the sensitiveness you increase the liability of incineration, which may perhaps give you burned coal, your explosive not being in the best condition for firing. The Bureau of Mines and everyone interested in the subject, would recommend that the operator instead of reducing his cartridge size, get a larger air space, and they would suggest you increase the size of the drill hole and continue to use the large size cartridges."

MR. NELSON:

"There seems to be an increase in the confusion as to what cushion blasting does. There are so many who seem to believe if we can increase the space around the powder that we have cushion blasting, regardless of how long or how short the charge is. I know of no tests, or the results of any tests which show any advantages from larger air spaces around the cartridge. The main thing in shooting coal as I see it is to balance your shots. If your shots are balanced by having the powder at the very back of the hole, you want the air blasting the length of your charge. As I brought out in my paper, what is true in your condition may not be true in some other condition. In West Virginia in low seams, it is the practice to use long cutter bars. Is it reasonable to think that by increasing the size of the drill hole and having the powder at the back of the hole you are going to put a 3-foot hole or a 9-foot cut? You bring the length of the charge toward the front, cut the air space for the cushion blasting the length of the charge, getting the shot balanced before the explosion. You are unable to get it by any other method unless you use a hole in which you drill half the depth of the cut or the height of the hole and shoot your series of holes. One coal company interested in lump coal uses 1⅛" cartridges of a certain permissible explosive. We have carried out some tests, in which we cut the stick of powder in two parts, putting the two halves of powder a certain distance apart to see whether or not the wave carries the half stick and ignites the other half. With no protection, just lying on the ground we found the gap in testing the detonation was 12".

"Perhaps you carry their sensitiveness or lack of sensitiveness in the smaller diameters a little too far. I have known 1½-in. cartridges which had been in the magazine at the mine for eight months to give good results—no mis-fires or burning in the holes."

MR. LUBIN:

"The question of sensitiveness brought up by Mr. Marvin is rather interesting, especially with cushion shooting. The standard was 1¾ inches but some have cut it down to 1½ inches, some to 1¼ inches and others to 1⅛ inches. In tests made by the Bureau of Mines with these explosives—the 1½-inch did not pass and the 1¼-inch did—some passed all the way down to 7/8 inch. They have made numerous tests with explosives and we will have to go by what they call the standard. Unfortunately the men in the field can not run tests on their explosives and the Bureau of Mines appears to be the standard that we will have to follow. If they approve of the 7/8-inch, why use a 1⅛-inch? If the size recommended should not be sensitive, there is certainly something wrong with the tests and they are not of much value to the operating men consulting those tests. Some will not pass and some will pass, all the way down to 7/8-inch and might have passed at a lower diameter."

MR. KEELY:

"I am interested in coal near the center of a 7-foot seam. We have had trouble keeping the men from shooting the coal to pieces with such heavy charges, which, of course, resulted in failure to get as much lump as we would have otherwise, because of the number of charges and the extra shooting. What has your experience been in regard to this cutting of coal in the middle, in order to make the least percentage of fine coal?"

MR. DUNBAR:

"What type of machine do you use?"

MR. KEELY:

"Arc machine. In the State of Alabama the machine was not a success on account of being too close to the bottom, so they cut the coal with a 10-foot cutter bar, reduced the amount of explosive by using less powder, making more holes, but there was an excessive amount of fine from the center cut."

MR. MILLER:

"Have you had experience in cushion blasting where the men do their own shooting?"

MR. NELSON:

"I have had no experience where the men do their own shooting. At all of our plants we employ someone to do the blasting for our men. Where the men do their own blasting instead of having men trained in the use of certain methods, of blasting, certain placements of holes, you have instead the entire force of miners in your mine. At best it is very difficult to obtain a uniform result because each man has his own idea as to the place that should be shot, and as soon as his attention is turned to something else he goes back and if he has been away for a time, he will find it was not where he intended it should be. Many times you will find you have nearly as many placements of holes and methods of blasting as you have men, and I am afraid that in order to get a uniform method you cannot depend upon the individual miners themselves. If you are enough interested in lump coal to employ men to shoot, supervise and carry on the shooting operations, then you can get uniform results. They have been given instructions and if the hole is not properly placed they will not shoot it, and they will put in powder that their experience teaches them is proper. I very much fear the use of cushion blasting would be difficult where the men do their own blasting."

A discussion followed by several who had had little success with the Arc machine with various conditions. Suggestions were made, and it was argued that if given the proper conditions the Arc machine would do its work.

The War Department in its report to Congress on pollution of streams said that industries engaged in the production, storage and transportation of oil are installing more efficient recovery devices and are more zealous in their effort to prevent escape of oil into streams by accident or otherwise.

Minnesota and Wisconsin have appointed a committee to investigate pollution on the upper Mississippi River and other boundary waters between those States, although pollution of these waters is said not to endanger commerce, navigation or fisheries.

PREVENTING MINE ACCIDENTS

Three Phases of Accident Prevention Work Were Discussed At The Cincinnati Meeting, Including "Proven Advantages Of Rock Dusting," "Sealing Fires In Gaseous Mines," And "Fire Protection Underground"

J. J. RUTLEDGE, State Mine Inspector, Baltimore, Md., acted as chairman of the sessions devoted to Accident Prevention, the first paper presented for discussion being

PROVEN ADVANTAGES OF ROCK DUSTING

By A. C. CALLEN, University of Illinois, who said:

"I shall interpret the subject to mean 'Proof That Rock Dusting Will Stop an Explosion,' and I shall endeavor to present the arguments in a logical order and in concise form.

"I take it that we will all accept as an axiom the statement that bituminous coal dust suspended in air in a cloud of sufficient density will explode, either with or without the presence of methane, provided there is a suitable source of ignition which may be furnished by an open flame, by an electric arc, by long-flame explosives, or by the primary ignition of a body of firedamp. More than 13 years ago the statement was made in one of the Bureau of Mines publications[1] that 'the fact that coal dust in air containing no inflammable gas may explode is now almost universally conceded in this country'; and as far as I know there have been no happenings since that time which would even tend to disprove the fact of the explosibility of coal dust. Laboratory tests, gallery tests, experimental mine tests, and disasters in operating mines unite in proving the point.

"Many of the facts regarding the nature and behavior of coal-dust explosions are known. The physics and chemistry of the explosion are comparatively simple, and if conditions are right, if the proper combination of circumstances arises, no bituminous coal mine that is not absolutely wet or that is not rock dusted either by man or by nature is free from the hazard of an extended explosion.

Experimental Mine Tests

"Hundreds of gallery tests in this and other countries have demonstrated that *rock dust will stop an explosion.* Tests in the experimental mine at Bruceton, Pa., have shown, time and time again, the effectiveness of rock dusting in limiting the extent of or preventing the propagation of a coal-dust explosion. The great advantage of gallery and experimental mine tests has been that exact control can be had over conditions, and the behavior of the explosion can be studied in detail.

"One of the early and yet one of the most striking explosion tests at the experimental mine was in 1914.[2] It was witnessed by the members of the American Institute of Mining Engineers who were attending the meeting at Pittsburgh, and by state mine inspectors from Pennsylvania, West Virginia, and Ohio. The explosion was made to travel a predetermined path by protecting certain portions of the mine with rock-dust stoppings and doors and by rock-dust barriers. Most of the section which was to be traversed by the explosion was loaded with a mixture composed of 60 percent coal dust and 40 percent shale dust, but pure coal dust was placed on the far side of each protective device so that if flame passed the rock-dust protection the dust on the other side would be ignited and the explosion extended. 'The test was entirely successful as a demonstration of the operation of various explosion stopping devices,' says Mr. Rice.

A. C. Callen

"Those interested in the details of the hundreds of explosion tests made at the experimental mine can find the material in Bulletins 56 and 167 of the United States Bureau of Mines. Not only has the efficiency of rock dusting been proven in these tests but the amount of rock dust required to render safe the coal dust from various localities.

"The Old Ben Corporation, which operates 12 mines in southern Illinois, was the first company in this country to use rock dust on a large scale, the work beginning in 1917. The method first used was to protect all entry intersections and to have rock-dust zones at 500-foot intervals. Later thorough coating of haulageways and openings 30 feet or less from the track has been practiced. Rock dust is also blown into the aircourses at intervals, and trough barriers used as an additional protection.

"The rock dusting of the Old Ben mines has been under the direction of J. E. Jones, safety engineer for the company. He is a man of ability, with a thorough understanding of mining conditions and of safety measures. As a mine official, as a state mine inspector, and as safety engineer he has won the confidence and respect of mining men. His opinion would be accepted as expert testimony by any court in the land. Hear him as he says:[3] 'Nine explosions have occurred, seven of which reached a rock-dust zone. The flame was extinguished by the first zone in the path of the explosion. Two were of enormous intensity in force and flame and undoubtedly would have been disastrous had it not been for the rock-dust installations.' He concluded his paper with the statement: 'The practice of rock dusting has proven to be practical in application, efficient in performance, harmless to mine and men, and reasonable in cost.'

"Time will not permit the detailed description of these explosions, but they have already been published[4] and are available to anyone. Great credit is due to the pioneer work of the Old Ben Corporation in proving on a large scale the value of rock dusting.

The New Orient Explosion

"On January 29, 1926, at 7.40 a. m., a local gas explosion was instituted at the New Orient mine of the Chicago, Wilmington & Franklin Coal Co., by a bratticeman who struck a match to relight his safety lamp. New Orient, as everyone knows, is the world's largest coal mine. There were 1,079 men at work, and only five were killed.

"A study of the map showing the details of the explosion, and of the correspondence that passed between the mine and the Chicago office, as well as a review of the transcript of the proceedings had at the coroner's inquest, indicate very clearly that the consensus of opinion is that rock dust prevented a disaster that would have been unparalled in this country and would have been exceeded only by the Courrieres disaster in France in 1906.

"The general superintendent of the company, Mr. Joseph Louis, wired Mr. Harrington a few hours after the explosion: 'Rock dust has prevented us from having an enormous loss today.' Mr. Rodenbush, superintendent of New Orient, in his report on the explosion said: 'We found * * * that the rock dust had killed the force of the explosion as soon as the blast hit the rock dust. I believe from the results I have seen that the rock dust did all that was expected of it.'

"At the coroner's inquest George Pollock, mine manager at New Orient, testified: 'The rock dust * * * prevented the explosion from spreading.' It was the opinion of all the men[5] working in the section of the mine where the explosion occurred that the rock dust prevented 'a very bad explosion and a great loss of life.'

"The day after the explosion a commission of four state mine inspectors, Gillen, Rossbottom, Plumles, and Hoey, acting under the authority of Director A. D. Lewis, director of the Department of Mines and Minerals, visited the mine to investigate the cause of the explosion. In forwarding the report of the commission to the company Director Lewis said: 'The commission also verbally reported that had it not been for the fine condition of the mine and for the fact that the mine was rock dusted very thoroughly, that undoubtedly you would have had the greatest disaster at your mine in the history of coal mining. The Department wishes to congratulate you for going

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[1] Bulletin 56, p. 8.

[2] Trans. A. I. M. E., vol. 71, pp. 1160-1163.

[3] A paper delivered before the Illinois Mining Institute, June, 1925. For extracts from this paper see Coal Mine Management, July, 1925.

[4] Descriptions of these and other Old Ben explosions are recorded by Mr. Jones in a paper published in the American Labor Legislation Review for March, 1924, and in Coal Mine Management for May, 1924. See also Mining Congress Journal, July, 1924.

[5] Report of Walter Nichols to Joseph Louis.

further than the law requires to make your mine safe.'

"Press despatches have emphasized the fact that rock dusting at New Orient had just been completed a month previous to the explosion. As a matter of fact, rock dusting began at this mine in the first half of 1924 when the mine was still on a development basis. Ten miles of entry had been rock dusted prior to June, 1924. The safety policy of the Chicago, Wilmington & Franklin Coal Co. has always been a progressive, forward policy.

THE HORNING EXPLOSION

"A few days after the New Orient explosion 20 men lost their lives in a violent explosion at a mine of the Pittsburgh Terminal Coal Corporation, at Horning, Pa. The explosion was initiated by a fire which originated by a cutting machine igniting gas, the ignition probably taking place in the starting box of the machine. The explosion occurred while this fire was being sealed off.

"This mine was in process of being rock dusted at the time of the explosion, and the haulage roads had been treated.

"One of the men who assisted in the work of recovering the mine, a general superintendent of a neighboring company, says in a personal communication: 'There were three parallel headings, Nos. 7, 8, and 9, No. 8 being the only one rock dusted. The No. 15 and 16 butt headings were the last turned off to the right and were not rock dusted. The explosion originated by a fire at the face of No. 16 butt heading, where a trip of cars was standing on the curve, which wrecked and turned over completely, closing off No. 9 heading. The flames were then shunted to No. 8 face heading, which was rock dusted. The evidence of flame and smoke was found only about 300 to 400 feet from this point out on the rock-dusted heading.'

"Testimony at the coroner's inquest by Mr. George S. Osler, vice-president and general manager of the company, was to the effect that he was certain that rock dust stopped the explosion from going any further than it did.

"A personal letter from one of the men who assisted in the recovery work states that 'Most of us who had to do with the recovery work after this explosion, and fighting the fire, are quite convinced that had not the haulage entry of the main south been pretty effectively rock dusted, the explosion would have crossed over into the third south section and probably killed a couple of hundred men who were on the way out of that section at the time.'

"The commission appointed by Joseph J. Walsh, Secretary of Mines of Pennsylvania, evidently was of the opinion, following the investigation of the disaster, that if rock dusting had been completed the explosion would have been confined to much narrower limits. This is the only possible interpretation that can be put upon the report of the commission when it says: 'To make rock dusting so effective as to confine flammation within narrow limits, all avenues of escape from the face of the workings must be liberally and systematically rock dusted, and this treatment be extended and maintained close to the face concurrent with the advance of the workings.'

VALUE OF EVIDENCE PRESENTED

"Neither the results obtained by the Bureau of Mines at the experimental mine nor the evidence offered by the men who have been quoted on the effectiveness of rock dusting in southern Illinois and western Pennsylvania are open to question. These men have had years of experience in the particular fields, they have had intimate knowledge of explosions in these districts prior to rock dusting, and they are fully competent to offer testimony as to what has prevented the extended propagation of these explosions. Their united statement is, in effect, this: *'Rock dust will stop an explosion.'*

"To quibble and argue in the face of scientific evidence supported unqualifiedly by actual experience is to show such an utter disregard for mine safety as to entitle one to contempt. If the evidence were only one-tenth as conclusive there would be sufficient reason for urging rock dusting.

FINANCIAL PROOF

"Most of us are inclined to believe that insurance companies are rather profitable concerns, and that whether it be life, fire, tornado, automobile, compensation, or insurance of whatever kind, the company makes its rates after gathering all the statistical evidence that is possible and after making every allowance for special hazards.

"The Associated Companies, of Hartford, Conn., is an association that is so well known to mining men all over the United States that it is not necessary to describe it or its rating work. In February, 1926, the Associated Companies issued Safety Circular No. 47, entitled 'Rock Dusting Coal Mines.' Illustrations were cited of instances where rock dust had proved to be effective—New Orient; Old Ben; Horning; Rains, Utah; Sturgis, Kentucky. The circular closed with these two paragraphs, printed in boldface type:

"'No bituminous coal mine operator can definitely predict that there will not be a coal dust or gas explosion in his mine, and the most effective safety precaution known to limit these explosions to a small area is rock dust.

"'We can not impress upon you too strongly the importance of rock dusting not only gaseous but nongaseous mines, and sincerely hope that you will give this subject serious consideration, and if your mine is not rock dusted that you will take such steps as are necessary to have it done immediately.'

"In April, 1926, Safety Circular 48 announced that on and after October 1, 1926, the Associated Companies will not insure for compensation any gaseous and/or dusty bituminous mine that has not been rock dusted, and, furthermore, the Associated Companies on and after October 1, 1926, will not issue a compensation policy on any bituminous gaseous and/or dusty coal mine until it has been rock dusted.

"Sprinkled or watered mines will not be accepted in lieu of rock dusting.

"When an insurance company refuses you insurance because of high blood pressure, a bad heart, or for other reasons, you at once begin to consider your case seriously. When an insurance company refuses you compensation insurance because your mine is considered too great a risk you should consider your case seriously. A mine which has not been rock dusted is such a risk.

CONCLUSION

"In closing let it be said that while the great advantage of rock dusting has been proven to the satisfaction of almost every mining man, yet even its strongest advocates have never recommended it as a cure-all. An explosion may be limited to a single panel or butt heading, but what about the men in that panel or in that section? Adequate ventilation, closed lights with magnetic locks, short-flame explosives, permissible machinery and competent officials and competent men, together with other safety devices and methods, are necessary if the ultimate in mine safety is to be attained."

***J. E. JONES**, Safety Engineer, Old Ben Coal Corporation:*

"That rock dust has proved itself as being of value in preventing the propagation of a mine explosion is now beyond question even in the minds of those who were at first doubtful. A decade ago it was considered by a few as a theory that might be worth a trial; today it is considered by many as good practice to eliminate this hazard which is the greatest disaster hazard we have in the mines of the nation.

"Flame can be extinguished by but two general methods although there are several applications possible of these two methods. These two general methods are the removal of the fuel and the cooling of flame below the ignition point. Rock dust installation embodies these two methods, first, by lowering the combustible content of the mine dust to below the burning point which is equivalent to the removal of the fuel, and second, when blown into suspension it absorbs heat suddenly reducing the temperature to below the ignition point.

"Rock dust distributed on the roof, ribs and timbers increases the ash content to such a high percentage that an explosion cannot propagate. If the dust remains dry and is blown into suspension it will also absorb heat. For mine dust, sufficiently treated with rock dust as to be non-inflammable, to be damp or wet does not mean that it will be non-effective. With such a condition the explosion will cease because of the lack of fuel.

"The installation of barriers, of whatever design, is to furnish curtains or clouds of rock dust in the event of an explosion that will absorb the heat so that the temperature is reduced to below the ignition point and the distillation of coal dust into gas will cease.

"The Orient explosion was stopped by rock dust by the first method mentioned —that of the combustible content of the mine dust lowered below the ignition point. I say 'stopped' because water had an excellent opportunity to stop the explosion and failed to do so. The entire section where the explosion originated was wet, very wet. The gas explosion originating at the entry faces was propagated by coal dust as evidenced by coke deposits. The only coal dust available was that which was a slush on the roof and ribs. Coking started at a point 100 feet from the faces and continued for 175 feet to a point 25 feet in the rock dusted zone. Rock dust installation was that of ribs and roof coating from the shaft bottom to within 250 feet of the entry faces. This rock dust coating was wet, very wet, slushy wet, and no barriers were installed in the vicinity. A rock dust cloud did not form and the explosion flame was extinguished by 25 feet of rock dusted entries because of the absence of fuel to feed it.

"Lives that are lost can be counted; those that are saved cannot, yet we believe that more than 1,100 lives were saved by rock dust in this instance. An extremely wet condition failed to stop the accelerating propagation of the ex-

plosion. Not many hundred feet back the mine conditions were dry. To those who have studied explosion hazards it is not difficult to imagine what might have been the result without the rock dust."

***CHARLES ENZIAN**, Chief Engineer the Berwind-White Coal Co.:*

"My comments of Professor Callen's paper, 'Proven Advantages of Rock Dusting,' will be confined to a short history and summary of the actual cost of rock dusting two gas coal mines of The Berwind-White Coal Mining Co., to a standard that made them pass the requirements of the Pennsylvania State Compensation Rating Bureau.

"The management of The Berwind-White Coal Mining Co. gave serious consideration to the subject of rock dusting its mines operating the Pittsburgh gas seam in Westmoreland, and the Lower Kittanning or low volatile seam in the Windber districts of Pennsylvania.

"Various officials of the company were assigned to study and analyze specific experimental appliances and installations in mines of several neighboring states and to study the experimental and research progress made by the U. S. Bureau of Mines, especially the coal dust explosion tests and methods of rock dusting employed at the Experimental Mine at Bruceton, Pa. During March, 1924, a large representation of our operating officials also attended the demonstrations and highly instructive lectures delivered on this subject at Pittsburgh, Pa., by American and English authorities during the visit of the English experts. Mr. George S. Rice represented the U. S. Bureau of Mines and Dr. Wheeler represented the English Department of Mines. Following these investigations all mines of this company were comprehensively sampled by the standard scoop and brush method, and chemical laboratory analyses made.

"All of the data were carefully analyzed by our Central Safety Committee which is composed of the operating officials of the company. That committee unanimously endorsed and recommended the rock dusting principle for coal dust explosion and fire protection in such mines where coal dust analyses indicated the possibility of dust explosion hazards. These, in respective importance were found to be: Ocean Coal Co., Maryland Coal Co. and Eureka No. 37 Mine at Windber.

First Installations

"The recommendation of the committee was accepted and the management directed that rock dusting be undertaken promptly and vigorously at the Ocean Coal Co. mines at Herminie, Pa., at the Maryland shaft mine at St. Michael, and several of the Eureka mines in the Windber district, which appeared to present the greatest potential hazards. The mechanical engineer of the company in collaboration with superintendents of the Ocean mines and Maryland shaft proceeded with the design and construction of two dusting machines. The Ocean machine was put into service in September, 1924, and the Maryland machine in December, 1924.

"The experience gained by the use of these two machines indicated certain changes should be made in size of fan and motor. During the past six months one improved machine has been in the Ocean mines and two improved machines have been in the Windber mines. These machines are giving excellent results. At the recent special trial of the last Ocean machine a crew of three men dusted 13,333 linear feet of entry in seven hours, placing 20 tons of dust, or at the rate of 3 pounds per linear foot. In common practice, and under normal conditions this crew dust 8,000 linear feet per 8-hour shift.

"As the Ocean mines of this company have had longer experience and have progressed to the stage of having 100 percent of its mines officially rated as 'standard rock dusted mines,' it is thought that the experiences and results gained at those mines would present the most interesting basis of discussion to this convention. Although equally good results have been attained at some of our other mines, but on account of greater magnitude and physical conditions beyond the control of the operating officials, these have not been completely dusted. We have therefore taken the Ocean results as representative of our average conditions and costs.

Standard Practice of This Company

Preliminary Work

"After detailed study of each local factor of the problem and determining the results to be accomplished, the mine officials concluded to carry out in respective order the following program: First, dust all but entries, room necks and stump workings; second, dust all panel entries; third, dust haulage entries; fourth, dust all room and complete the erection of dust barriers. The dusting of entries and the erection of dust barriers was done simultaneously.

"The dust barriers are placed in the air courses, because generally the tracks in them have been removed and full dusting therefore is impracticable. In most instances it will be found that considerable cleaning of drawslate or falls of coal is necessary before the barriers can be erected at the desired locations. The barriers consist of the standard improved V Trough type and are of sufficient size and number to contain 100 pounds of dust for each square foot of cross-sectional entry area. They are erected at the intersections of the main and butt entries so that each ventilating split of air is thereby sectionalized by the barriers. An explosion that might originate in any split of air should therefore be confined to the limits of that section by the barriers.

Preparatory Work

"One of the first steps in this work was to prepare the entries for the dusting process. The loose roof, slate and coal was carefully trimmed from the roof and ribs, and the accumulations of dust and small pieces of coal were brushed or washed off the timbers and ribs. All debris on the floor of entries was then thoroughly cleaned and loaded out. This work, of course, has to be

COST OF ROCK DUSTING TO PASS THE STANDARDS OF THE PENNSYLVANIA COMPENSATION RATING BUREAU

Total cost of labor and material used in rock dusting to May 1, 1926, including the cost of 2 rock-dusting machines, 64 complete sets of dust barriers containing 177 tons of rock dust:

Total cost of cleaning for barrier installation No. 1 and 2 mines	$871.18
Total cost of building barriers—64 sets	880.88
Total cost of building troughs	449.96
Total cost of painting barrier troughs and supports	167.10
Total cost of posts used in barrier installation (730-8-ft.)	240.90
Total cost of wood rails used in barrier installation (5,200-ft.)	140.40
Total cost of rock dust loaded in troughs—176.76 tons	1,025.21
Total cost of installing 64 sets of rock-dust barriers in No. 1 and 2 mines	$3,775.63
Total cost of dusting No. 2 and 1 mines as shown on daily reports	5,686.21
Total cost of construction of rock-dust car put in service at No. 2 mine Sept. 25, 1924	961.18
Total cost of construction of rock-dust car put in service at No. 2 mine Feb. 10, 1926	1,105.25
Total cost of miscellaneous material used in connection with rock dusting (cable reel, hose, exhaust pipe, etc.)	473.33
Total cost of sampling No. 1 and 2 mines	165.00
Total cost of power used in operation of cars	86.17
Total cost of oiling and greasing	31.40
Total cost of dusting No. 2 and 1 mines to date May 1, 1926, calculated from figures received from foremen	$12,284.17

Average cost of installing one barrier complete, including rock dust loaded in barriers, labor building troughs, labor building barriers, material used in construction of barrier, and cleaning:

Average cost of cleaning for barrier installation	$13.61
Average cost of labor building barriers	23.41
Average cost of material used	21.97
Total average cost	$58.99
Average cost per ton of coal produced per barrier—period covered Sept., 1924, to May 1, 1926, inclusive—tons produced 1,127,804.50	.000052
Average cost per ton installing 64 complete sets barriers to date	.00335
Average cost per ton rock dusting to date	.00504
Average cost per ton labor and material constructing rock-dust car in service Sept., 1924	.00085
Average cost per ton labor and material constructing rock-dust car in service Feb., 1926	.00098
Average cost per ton miscellaneous material used in connection with rock dust	.00042
Average cost per ton sampling	.000146
Average cost per ton power used in operation of cars	.0000764
Average cost per ton oiling and greasing	.0000278
Total average cost of rock dusting per ton of coal produced	.01089

SUMMARIZED OPERATING COSTS

Two rock-dusting machines	$2,066.43	
64 complete sets of dust barriers (including 177 tons of rock dust)	3,775.63	
		$5,842.06
Labor operating dusting machines	$3,006.61	
462 tons of rock dust applied by machines	2,679.60	
Miscellaneous materials (power, oil, etc.)	590.90	
Sampling and analyses	165.00	
Total cost of applying dust by machines		6,442.11
Grand total cost		$12,284.17

Tons of coal produced during period of dusting	1,127,804.50
Average cost per ton coal produced of barriers and dusting machines	0.005180 = 5.2 mills
Average cost of applying dust by machines	0.005712 = 5.7 mills
Total average cost per ton of coal produced	0.0108921 = 10.9 mills

Fig. 1.—Condition of entry before cleaning

Fig. 2.—Condition of entry after cleaning and before rock dusting

Fig. 3.—Entry after rock dusting

Fig. 4.—Timbered entry after rock dusting

Fig. 5.—A rock dust barrier

Fig. 6.—Rock dusting machine in operation

Mr. Enzian's Paper.—Rock Dusting at the Berwind-White Coal Mining Company

done whether rock dusting is done or not, but should always be done before rock dusting is started.

Quality and Cost of Rock Dust Used

"At the Ocean Coal Co. mines, New Castle limestone dust of 67 percent through 200 mesh screen dust is used. At the Maryland Coal Co. mines, Palmer Challenge Brand of 91 percent through 200 mesh screen is used. The former costs $5.80 per ton f. o. b. mines Herminie, Pa., and the latter costs $5.95 per ton f. o. b. mines St. Michael and Windber, Pa.

Amount of Dust Applied

"In the butt entries, room necks and stump workings dust was placed to the amount of 3.0 pounds per linear foot. In panel and main entries 2.7 pounds of dust per linear foot was placed. In rooms the dusting was carried to the last cross-cut and the ribs, roof, floor and gobs received between 3 and 4 pounds per linear foot of room length.

"During the period September, 1924, to May 1, 1926, the Ocean mines placed 639 tons of limestone dust in the haulage entries, rooms and air-courses barriers. Of this amount 462 tons was applied in the mine workings and 177 tons in dust barriers. Rock dust at an average of 2.7 pounds per linear foot was applied and re-applied over a total linear distance of 88.9 miles of mine workings.

Redusting Practice

"The mines receive periodic sampling. This is done by the standard method of scoop and brush and the analyses of the samples are made by volumeter method. Redusting of the workings is done when by visual inspection, checked by the volumeter analyses of samples indicates its necessity.

"All entries are sectionalized by placing 6 inches square numeral markers at 500 feet intervals from the origin of each entry.

Discussion of Costs

"It will be noted that many items included in the total cost are of more or less permanent characters; such as the cost of building and installing the barriers and the investment in two rock dusting cars. These items amount to a total of $5,842.06, or at the rate of 0.0052 per ton produced during the period under discussion.

"Deducting these two groups from the total of 10.9 mills, and taking into consideration that a much lesser amount of dust per linear foot of workings will be required in the future; also that our men have become more expert in applying the dust and that our new dusting machine is more efficient than the first installation, we feel quite confident that the future cost of rock dusting will not very much exceed 6 mills per ton.

THE ECONOMIC ASPECT OF ROCK DUSTING

"Aside from the moral and psychological effect that rock dusting has on the employes and operating officials of the mines, and the greater safety assurance, there is a distinct economic return from rock dusting. As a result of rock dusting these mines have been relieved of a dust penalty of 5 cents per $100 of pay roll, and have all been credited with 10 cents per $100 of pay roll, in accordance with the Compensation Rating Bureau's regulations. On the average annual tonnage produced this is the equivalent of two mills per ton, which would make the net cost of maintaining the dust proof conditions of these mines about four mills per ton.

"Another great benefit to be derived from rock dusting, however, is that intangible return measured purely in peace of mind of employees and employer; in the satisfaction of accomplishing efforts to reduce the possibility of coal dust explosion catastrophe hazards; the moral comfort in the recognized fact that the precautionary methods are in accordance with the adopted standard of safe mining practice, and the assurance that one has

OCEAN COAL COMPANY

ANALYSIS OF ROCK DUST SAMPLES

SAMPLE PERIOD_____ TO_____

LOCATION	DATE DUSTED	DATE SAMPLED	ROOF AND RIBS		ROADWAY		REMARKS
			CONDITION	% ROCK DUST	CONDITION	% ROCK DUST	

Form 101-3-25

OCEAN COAL COMPANY

OCEAN_____ MINE RECORD OF ROCK DUSTING _____ 192

LOCATION	Date Dusted	No. Lbs. Used	Distance in Feet	Pounds per Foot	Time in Hours	Labor Cost	Material Cost	Cost of Handling Material	Total Cost	Cost per M Feet	Date of Analysis	Analysis
TOTAL												

Form 102-2-25

OCEAN COAL COMPANY

HERMINIE, PENNA.

RECORD OF ROCK DUSTING

MINE NO._____ _____ 192__

LOCATION	No. Feet Dusted	No. Sacks Used	No. of Men and Rate	No. Hours Worked	No. Lbs. Per Foot

_____
Mine Foreman.

This report must be kept each shift that Rock Dusting is done, and must be correct, and forwarded to this office immediately after work is done.

B. F. WILLIAMS, Supt.

Mr. Enzian's Paper. Above, sample locations and volumeter determinations. Center, superintendent's monthly and annual report. Below, foreman's report at each rock dusting.

Fig. 1

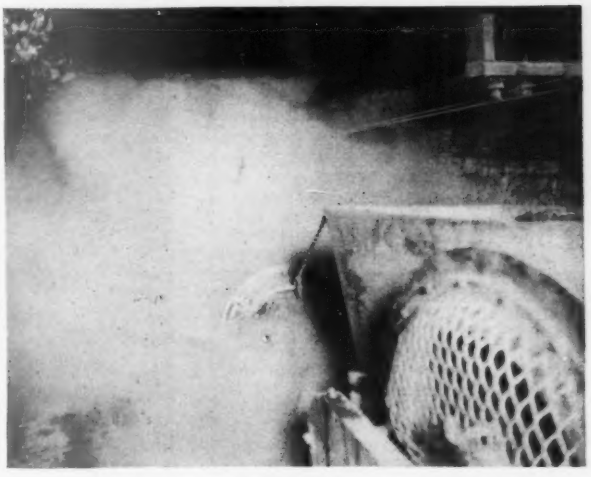


Fig. 3

done all that it is humanly possible to do to meet the organic purpose of the legal and moral obligations we bear to the lives of workers entrusted to our guidance and care, and the preservation of the property committed to us for safe and economic management."

***T. E. JENKINS,** Vice-President Kentucky Coal Co.:*

"Our company rock dusted all mines operating in the No. 9 seam in 1924, all the dry mines, and all the mines that generate gas have been rock dusted since that time. On June 8 last, there was an explosion in No. 9 mine, which resulted in the death of 17 men. These men were all working within 700 feet of the initial point of the explosion, and 43 men who were but 600 feet farther away were unharmed. No doubt if the mines operated by the West Kentucky Coal Co. had not been thoroughly rock dusted, that explosion would have resulted in the death of the men working on the east side of the mine, somewhere in the neighborhood of 125 men. So we believe in rock dusting. We do not carry compensation insurance; we carry our own, and we believe that it pays. The cost to us has not been so great as to have any appreciable effect on the cost sheet. Mining room entries and haulage roads have all been thoroughly rock dusted.

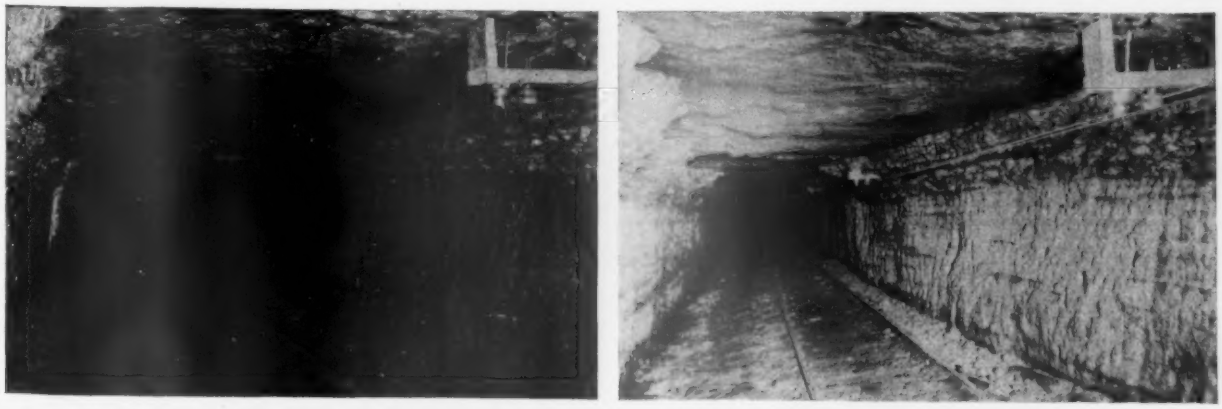
Fig. 2

Mr. Olser's Paper—Rock dusting machine

"We had another experience several years ago which strengthens my belief in rock dusting as preventing an explosion from spreading. In 1917 a very disastrous explosion occurred in a mine in which I was interested. The explosion, when it reached the haulage entry where there was a great deal of sand was entirely stopped and there was no indication where the explosive picked up the sand on this entry. Where there was no deterrent element it reached the air shaft and surface ground. I understand that throughout our particular field, steps are now being taken by all operators in that field to secure the necessary machines for rock dusting. I think this will be a matter that can also be handled as well by the small operators in a community. They can get together and purchase a rock pulverizer and work on the cooperative plan, build their own machine and use their own rock dust. We find the cost per ton is about $4.60, in sacks distributed to the mines. It is necessary in the No. 9 seam to use from 4 to 4½ pounds of rock dust per linear foot. We do not remove barriers from old works, but leave the abandoned mine well covered with rock dust as a protection against explosion at any time."

***GEO. F. OSLER,** Vice-President Pittsburgh Terminal Coal Co.:*

"We have a few slides to present; Mr. Ryan furnished a couple and our company had a couple made. The last slide, by an irony of fate, was taken just four days before we had an explosion in the mine, and is the one I am going to speak about. We had just

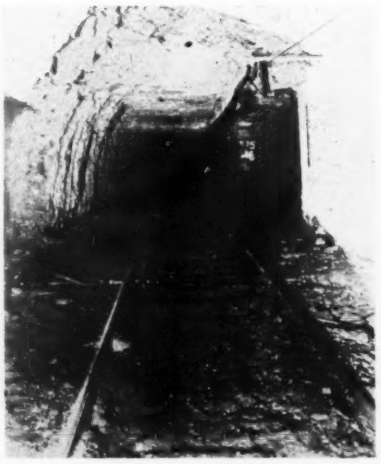


Mr. Osler's Paper.—Entry, Pittsburgh Coal Company, showing the lighting effect resulting from rock dusting

taken some pictures of the mine, the bottom, tipple, and everything around the mine, the rock dusted entries and the entries where we had the explosion in which 20 men were killed.

"These were to have been used in connection with an article, but we did not want to publish an article on rock dusting, and in the same issue describe a disaster. We have prepared a map which will show the effected area of this explosion. Figure 1 shows one of the types of machines used in Pennsylvania district for rock dusting. Operators are all familiar with this machine. A great many mines have this machine shown in slide No. 2. It is a different type and throws the dust up against the roof and sides. Both machines are effective for rock dusting and there isn't much difference.

"There is no use going into detail as to the effectiveness of rock dusting, as far as any theory goes. In the map I am going to show you the sections of the mine affected by the force of flames, and the effects of the explosion which started while we were sealing up a mine fire. The fire started while cutting the clay band in No. 4 mine, at No. 16 butt entry. The required official was with the cutter, and he was there when they cut the clay band. They cut 1½ feet and started on the left hand cut when gas was discovered. The men have described this differently. Some said there was but a small amount of gas and others say there was a great deal. We got this information second-handed. The assistant mine foreman, Mr. Denard, told Mr. Ernst in the presence of others, who happened to go out before the explosion, that there was but a small amount of gas. He stopped the machine and for some reason or other instead of pulling the machine back with



At mouth of No. 15 and 16 butts where explosion occurred

a steamboat ratchet as is usually done, it was pulled back on its own power. When they put this power on, it started the fire. It was a No. 7 Sullivan machine and they were having trouble with the starting box. It started about 10 o'clock and we fought the flame until 2 in the afternoon. The fire picked up a little bit in size and it was decided to seal it off. We were in the process of sealing when an explosion occurred. This explosion did not really knock the stoppings out. The 14 men were right close to the fire stoppings, and there were other men on other entries. The fire started at the face of butt No. 16, and the explosion and flame extended as close as we could tell, over the sections designated in red and yellow as shown on the map."

Mr. Osler, with the aid of a map, showed the trend of the fire and of the force of the explosion. He showed how rock dusting had prevented the explosion from going farther. Mr. Osler said that there were 280 men on the next set of butts, and 680 men employed at the time in the mine, and he said he was sure had not certain portions been rock dusted, that there would have been a very great loss in lives.

Discussion:

MR. ENZIAN:

"Please state how far back faces 7, 8 and 9 were rock dusted."

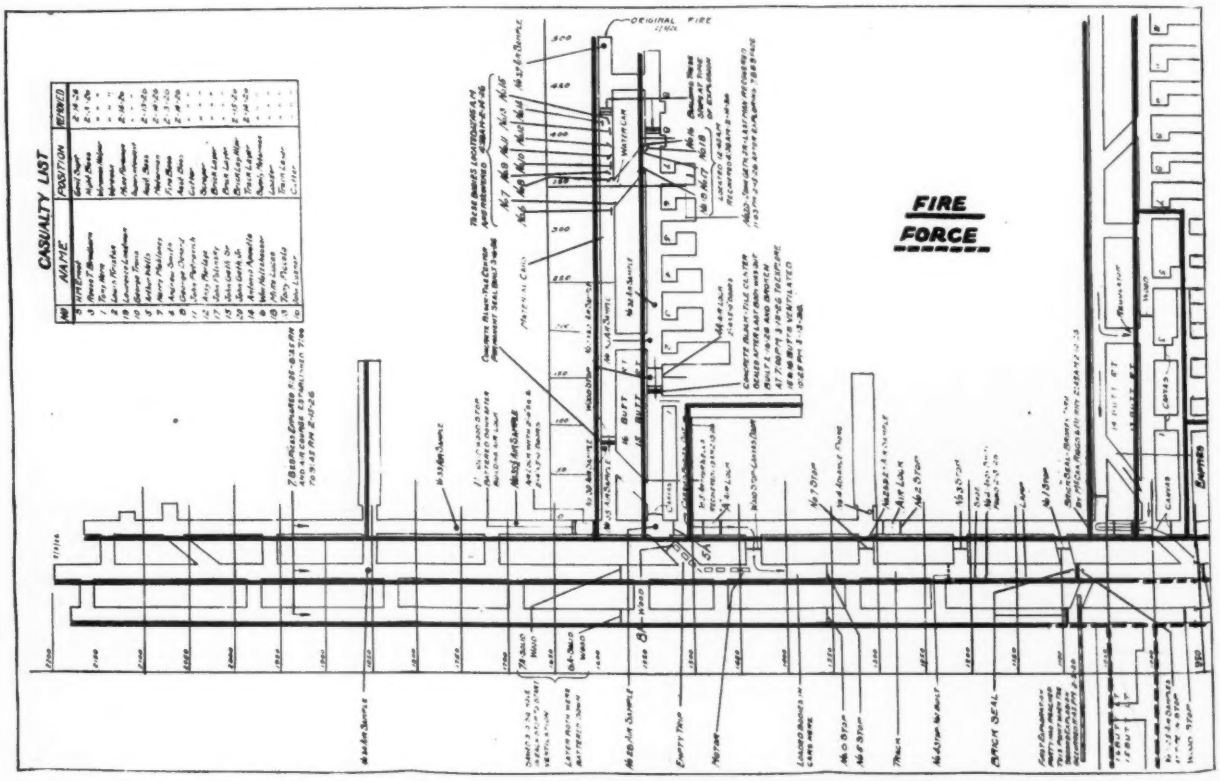
MR. OSLER:

"We were in the process of rock dusting at the time, and only the entry had been rock dusted. We had been at it about four days.

"I am strongly of the opinion that to make rock dusting effective, we want to get it to the faces. The air courses take care of the other parts of the mine, if you keep the open faces well rock dusted. My experience has been that every fire, which has been the source of a lot of explosives, started at the face. The problem we have to take care of now is how to rock dust these entries. Barriers will do a lot of good, but rock dusting the entries themselves would be more effective."

MR. EUGENE MCAULIFFE:

"I am very much in accord with the theory of rock dusting and am very glad to endorse everything Mr. Callen, Mr. Jenkins and the other gentlemen have said on the subject. I think, however, we should keep in mind that rock dusting is merely a limiting agent. The



Area effected by explosion, February 3, 1926, Pittsburgh Terminal Coal Corporation

thing that is giving me concern today is this—that too many of us are rock dusting inadequately, and taking this rock dusting as something of a soporific, something to make vigilance in the matter of ventilation and the keeping down of coal dust in a sense unnecessary. Perhaps we do that unintentionally, but the effect is substantially the same. I look on rock dusting as the third line of defense. It has advantages other than that of safety; it adds to the visibility and makes travel easier and safer and reduces accidents in haulageways and elsewhere. Particularly from those that occur from explosions. Our Wyoming properties are rock dusted, but not completely. That is to say, we have put 1,200 tons in our mines. We have a mill working all the time, that is daily grinding out rock dust, about 80 percent of which will pass the 200 mesh screen. The dust is expensive, as it costs us about $9 a ton at the mill in sacks containing about 60 pounds. We spent last year approximately $27,000.00 on rock dusting, which approximated 9 mills per foot apart from the capital invested, labor and maintenance. We are using very satisfactory material, called White Mountain shale, trucked to the mill, then transported and distributed to the machines in pit cars. It is our job to try and stop those things before they start. I am irrevocably and completely sold on the proposition of ventilation for mine safety. We are not always getting ventilation, not getting as much as we could or ought to be getting.

"Next the matter of coal dust, a recognized explosive agency. We have this checked as much as it is humanely possible to check it at the point of production. Acting on that theory during the last few months we have put in 56 miles of water line in our mine, a lot of gas pipes, garden hose, etc. We have equipped the mining machines with water pumps and force water down to the working places.

"Above and beyond that situation, I am proud of the fact that we have sunk five new air shafts to bring the air down towards the working face, reducing the friction, and increasing the volume where it is wanted. We have purchased Dunhite machines for the purpose of reinforcing, and making more tight our stoppings. The great danger lies here.

"Companies perhaps financially embarrassed, or fearful of the expense, will apply a limited amount of rock dust to their mines and perhaps feel this is a balm to their theory of safety. I do know of mines in this country that are called rock-dusted, that are not rock-dusted. Ours are not fully rock-dusted, not to my satisfaction. We have barriers of rock-dust through the entries and air courses. We rock-dust the air courses, bringing the air through the holes in the stoppings, depending on the air current to carry it back. But I do not consider the nine mills that we spent last year, an adequate expenditure. It is not a question of money with us so much as getting the work done and getting it into the mines. That work we expect to keep up. Some criticism has been directed against rock-dusting. Some well informed, well intentioned men have said it is superfluous. I totally disagree. I am irrevocably with the Bureau of Mines, with Mr. Jones, and with every other man who is for it; but I want to warn you with a great deal of solemnity, that it is a mistake to put too much reliance on rock-dusting when not efficiently done."

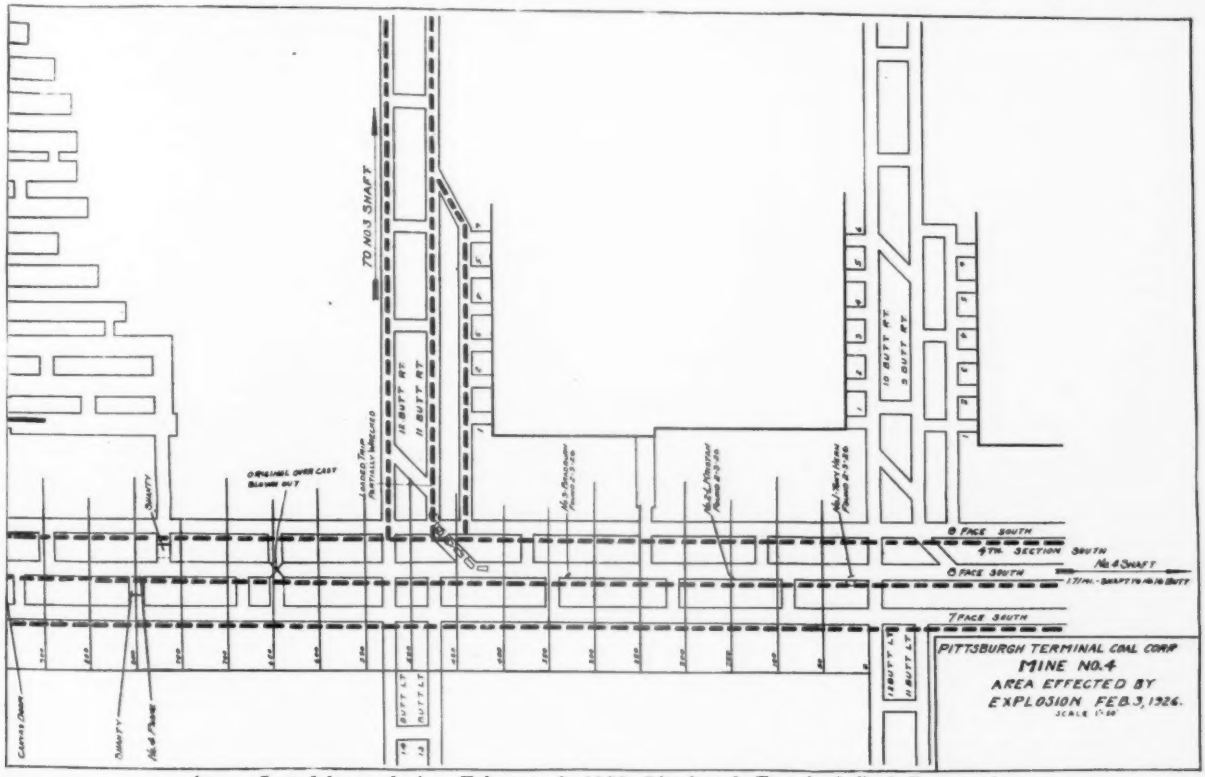
SEALING FIRES IN GASEOUS MINES

***JOHN T. RYAN**, Pittsburgh, Pa.:*

"When they gave me the subject 'Current Practice in Sealing Mine Fires,' I thought it a simple one, and I sat down one evening and said to myself: 'Just what is the current practice; is there such a thing? I am going to find out.' So I shoved the responsibility off to some of my friends. I drew up about 21 questions, got it up in the form of a questionnaire and sent it out. Inside of two weeks I had 48 replies, and when I had closed the discussion I had 67 complete replies. Since that time I received eight additional ones, which represents a total of 75, out of a total of 90 that I sent out to prominent mining men throughout the United States, Canada and Great Britain. There has been considerable experience in fighting mine fires and this will illustrate the great interest in this subject. But as regarding current practice, I did not find out very much. There is a great difference of opinion, and rightfully so, because you cannot pick any fire out of its surroundings and handle it in any cut and dried manner. Each fire has its own peculiar problems and its surroundings have to be considered. There are certain fundamental considerations which should be taken into account and I believe that the analysis of all of these replies gives a wonderful volume of information. There were 21 questions and there was at least 80 percent agreement on 18 of them. On two questions unfortunately, No. 5 and No. 6, there was a disagreement."

Mr. Ryan's paper in full follows:

"Every mine has its own peculiar fire hazard, whether it be a metal mine or a coal mine, and controlling fires is a haz-



Area affected by explosion, February 3, 1926, Pittsburgh Terminal Coal Corporation

ardous undertaking. They all have to be either fought direct and extinguished by water, or loaded out, or sealed off to exclude air and gradually extinguished through lack of oxygen to support the flame.

"The most hazardous underground fire to combat, in the writer's opinion, is one that breaks out in a bituminous coal mine which is generating explosive gas. There is not only the danger of a gas explosion, but the greater hazard of a small gas ignition at the seat of the fire igniting the coal dust. If this coal dust has not been rendered harmless by a coating of inert dust, it will propagate throughout the mine, thus endangering everyone underground and even those on the surface who may be in the vicinity of the mine openings.

"A fire in a gassy anthracite mine is just as hazardous from the standpoint of a gas explosion but the dust is not a factor, and distance from the fire is some measure of protection in case of an explosion.

"When asked to prepare this paper on the subject of 'Current Practice in Fighting and Sealing Fires in Gaseous Mines,' the writer realized that the practice varied greatly on account of different conditions and different ideas on the part of mining men gained from their experience in a particular district. To obtain information that would really be representative of present-day practice, an interrogatory consisting of 21 questions was prepared and sent to a number of mining men in the various coalfields of the United States, Canada, and Great Britain. The men selected were known to have had considerable experience in fighting and sealing fires in gassy mines. In addition, the questionnaire was sent to seven metal-mine engineers who have had unusual experience in controlling fires in metal mines, in order to get their point of view.

"The classification of the men who replied to the questionnaire and whose names will be found at the end of this paper, is as follows: 28 operating officials; 11 company mine inspectors; 14 chief mine inspectors; 4 district mine inspectors; 13 mining and consulting engineers; 10 Bureau of Mines engineers; and 12 directors of safety and central mine-rescue stations.

"Complete replies were received from 67, representing 73 percent of those asked. Two acknowledged the questionnaire and regretted that they were too busy just then but would send in their answers at a later date; four more advised they were preparing their answers but same were not received in time to be used, so it may be considered an 80 percent response. It is extremely gratifying to record this because the answering of all of these questions required considerable time, and this high percentage of response indicates the interest that is attached to this subject. A large number of replies were so comprehensive that any one of them presented in its entirety would have made a fine paper for presentation at this meeting.

"The writer gratefully acknowledges the hearty cooperation and prompt response of the men who replied to the questionnaire from which this data has been compiled. For assistance in the compilation of the data the writer is indebted to M. W. von Bernewitz, Pittsburgh, Pa.

The Questionnaire and Answers

Question No. 1

"Do you endeavor to fight the fire direct and exhaust every possible means of controlling it before resorting to sealing, or do you resort to sealing without much effort to fight it direct?

Answers

Anthracite Mines

"The anthracite operators are unanimous in fighting fires direct. At one colliery, all equipment and plans are made for this procedure. Direct methods should be continued as long as there is a reasonable degree of safety—that is to say, while there is little risk of explosion.

Bituminous Mines

"The concensus of opinion (82 percent) of bituminous operators is that fires should be fought direct until forced to seal them off; a number of others are not decided on the procedure, and a few would seal at once in the majority of cases, including lignite mines. In general, however, every mine is a problem in itself and it is a matter of conditions and the stage that the fire has reached, as may be judged by the following considerations:

"Some of the operators that would fight direct consider that the position, intensity, and extent of a fire and facilities and supplies immediately available should govern procedure. Those fires that are in the incipient stage are relatively easy to control, but when they have been burning for several hours the problem is difficult and one fraught with risk of explosion of gas or fall of roof. Safety should be the first consideration, although one engineer believes that more men are killed or injured in sealing fires than in direct fighting.

"Some opinions as to locality of fires and methods of attack may be summarized as follows:

"(a) If a fire is along a main haulage it may be fought direct, but if in solid workings not much chance should be taken and it should be sealed at once.

"(b) If in a solid heading or room first try the direct method but if on a heading or say around a side track or pump-house, and the fire has a good start, seal it off at once.

"(c) If we have a face fire we always fight it, and with success as a rule. We have a number of worked-out and caved areas. These we don't try to fight as they are usually caved so high that it is impossible to fight them; we seal this type of fire at once.

"(d) The position of the fire and its effect upon operation of the mine is to be considered.

"(e) It is not practicable to seal many mine fires on account of breaks to the surface in pillar or outcrop work and where no effort has been made to isolate panels. However, the first efforts should be to fight the fire direct.

"(f) Gob fires in worked-out areas can seldom be reached and must be sealed. In fact, in our mines which are subject to gob fires, the workings are so laid out that they may be sealed in small areas with few seals—generally not more than four and sometimes only two.

"(g) In one mine where a fire was fought direct with water and then sealed and carbon-dioxide gas forced in through boreholes from the surface, owing to the shallow cover and difficulty in keeping surface cracks shut, seals were broken after a period and the fire was again fought with water until it was extinguished.

"Several operators are quite decided on the point of sealing at once and say:

"(a) It is a waste of time and money to attempt to fight a fire of any great magnitude by the direct system.

"(b) No chance should be taken; if it is safer to seal it up, that should be done.

"(c) Where direct methods for fires in the incipient stage are impossible, sealing should be done at once.

"(d) Generally seal as quickly as possible; then revert to other methods if sealing is going to interfere with the operation of the mine.

"(e) In most cases, equipment is not available for fighting direct, which makes it necessary to seal nine out of 10 times.

"(f) Mines that are gassy and liable to gob fires are laid off in panels, and whenever a fire spark is detected and analysis shows carbon monoxide in the return, the panel is immediately sealed off.

"(g) It depends upon the gas hazard; if not great, we endeavor to extinguish fires.

British Practice

"(h) We pay special attention to the prevention of the outbreak of fire and endeavor to find out as soon as possible when a fire is smoldering, and stifle it before it becomes really dangerous. We pay particular attention to the analyses of return air, and especially note the decrease in the percentage of oxygen and the ratio of carbon dioxide and carbon monoxide to the decrease of oxygen. These ratios do give us some information as to whether undue oxidation is taking place, with the consequent risk of spontaneous fire. When we get undoubted signs that a fire is about to break out we employ two methods for dealing with it: (1) dig it out, or (2) seal it off. The method employed depends upon circumstances: In longwall workings, such as in the Barnsley seams, South Yorkshire, it is almost invariably the practice to dig it out, and sealing off is resorted to only when digging out has failed. In the workings in the thick coal of Staffordshire, where forms of board-and-pillar methods are employed, sealing off is employed because digging out would be useless.

Metal Mines

"There is unanimity that fires in metal mines should be fought direct with due regard to safety. Of course conditions greatly differ from those in coal mines. In the Coeur d'Alene district of Idaho, only one of seven fires was sealed. Under some methods of mining, such as slicing or square-set timbering, bulkheading is practically impossible. One engineer says:

"Practically all of our fires are of accidental origin and the first 30 minutes is worth weeks later. If direct action is best or we can aid direct action, we start a secondary operation to control ventilation or seal. This, however, we feel is defensive rather than offensive. Where fire is inaccessible we have warning weeks in advance of an outbreak and it can only be handled by indirect action, which means sealing.

"Another engineer says:

"In case of new fires, yes. In case of recurrence of old fires we usually seal

immediately and then resort to diamond drilling.

QUESTION No. 2

"What equipment do you recommend to have installed and available in the mine for fire-fighting?

ANSWERS

Anthracite Mines

"Of the five anthracite engineers, four recommend the use of the portable type of fire extinguishers, one with a chemical engine, and the fifth suggests a chemical engine alone. Also, four would use water either forced through the compressed-air pipe lines or from the regular water supply. Two lists of equipment may be quoted:

"(a) We recommend the following equipment: Hose, with fittings to suit; fire extinguishers and extra charges therefor. Tools, such as picks, ax, shovel, hammer, saw, nails, and drill. Because of conditions we are forced to place air lines in nearly every workable section and so arrange what we term a 'cut-in' on the surface with fresh-water lines. In the event of fire we are able quickly to turn water into our air lines and by so doing have what might be considered a fire line in practically all sections of our mines.

"(b) We recommend the following equipment: A chemical engine, and fire truck and tank, each mounted on a separate mine truck. The chemical engine should consist of two 90-gallon soda and acid tanks with 300 feet of ¾-in. hose. The truck is for extra soda containers, axes, picks, shovels, bars, and special bushings for all sizes of pipe for standard hose connection, and 250 feet of hose. The tank should be of 450-gallon capacity with hand pump for filling tank or discharging the tank to the chemical engine. Fire extinguishers of 1-gallon carbon tetra-chloride and of 2½-gallon special soda and acid types should be carried.

Bituminous Mines

"While four mines report that little or no fire-fighting equipment is maintained inside, 29 others use water from pipelines installed for that purpose or for drainage purposes, or for sprinkling coal dust; two convert the air lines into water lines; several use pressure tanks and some use barrels, placed at strategic points, and all are fitted with or for hose connections and nozzles. Some operators that use water also recommend fire extinguishers (the tetrachloride type for electrical equipment) or chemical engines or tanks, while others would use the fire extinguishers and tanks alone. An interesting development is the use of rock dust, either by shovel or by machine cited in 18 cases, and sand for electric fires. In addition to this main equipment, accessories such as brattice board or cloth, tools, brick or tile, cement, safety lamps, carbon-monoxide detector and approved gas masks are recommended to be kept in properly maintained places underground. Two engineers advised the installation of tight doors to isolate any section of a mine from all others in case of outbreak of fire.

"Two answers may be quoted at length:

"(a) We recommend the following equipment: Water lines along main haulage-roads with connections to parallel entries through crosscuts or crosscut stoppings where hose may be attached. These are primarily for sprinkling, humidification, and fire prevention; secondarily for fire-fighting. All underground stables should be provided with automatic spray or flood system. Portable fire extinguishers of the acid-soda or foamite type may be placed at partings for use in rooms and the carbon-tetrachloride type for electrical equipment.

"(b) All our mines are piped to within 25 feet of every working face and all places kept open are piped with water under not less than 40-pound pressure. Incipient fires are treated with water first. There is always plenty of brattice and timber available. Since rock-dusting has been in vogue we have rock dust which can be used by hand or by using water pipes and our stationary and portable air compressors. We can dust on a fire in that way. We also have rescue apparatus and supply parts always ready for immediate use.

Metal Mines

"All of the metal-mine engineers were in accord as to the need for fire extinguishers (one distinguishing between carbon-tetrachloride type for electric equipment and the acid type elsewhere), and the use of water lines and hose or connection between water lines and air lines. There may be a separate system of water lines, but in many mines these do not extend to all workings and air lines do, therefore the water may be turned into the latter. One engineer recommends that carbon-monoxide gas masks may be kept in cabins. Another would have self-rescuers and at the shaft a cabinet of ½-hour oxygen breathing apparatus, tools, and sundry pipe connections. At pump-rooms, timber stations and shaft stations, should be fire hydrants with hose attached, also turret nozzles. Finally there should be a definite prearranged plan that is written and known to all.

QUESTION No. 3

"What equipment have you on the outside for the same purpose, that is to be taken into the mine in case of underground fire?

ANSWERS

Anthracite Mines

"What is kept on the outside of anthracite mines for fire-fighting is additional and supplementary to that already inside. In one case more fire extinguishers are taken in and in two cases additional chemical tanks. Tools and fittings are also available; also carbon-monoxide detectors, gas masks, and breathing apparatus.

Bituminous Mines

"'All of our equipment is kept in specially built rooms in different sections of the mine,' to quote one engineer, and 'Keep it in the mine,' to quote another, is the practice at several mines, while at others a long list is given of items recommended to be kept on hand. The Smoke Eaters' Association lists 34 items of tools (including copper hammers), safety lamps, brick, portable telephones, buckets, rope, gas masks, and so forth. There is necessarily a wide difference of opinion as to what should be taken underground, but apart from additional fire extinguishers, and chemical tanks, tools, hose, brick or tile, and cement, eight engineers would take in a gas-sampling and testing outfit and carbon-monoxide detectors, and 26 (one a self-rescuer) suggest gas masks and breathing apparatus with extra supplies. First-aid supplies are needed. What is very important is a map of the mine, yet only two engineers mentioned it. And last but not least, an experienced organization led by a captain who knows his men and equipment.

Metal Mines

"Here again it is mainly a matter of supplementing what is in the mine, with fire extinguishers, hose, carbon-monoxide detectors, gas-testing outfit, gas masks, and breathing apparatus. At one central rescue station, trucks are always ready with the above supplies and tools, and have trained men acting under a trained director and organization.

QUESTION No. 4

"What inspection do you give your fire-fighting equipment?

ANSWERS

Anthracite Mines

"The general custom at anthracite mines is to inspect the fire-fighting equipment once a week. One engineer has it tested every month; another has the chemical truck tanks discharged once a month so that the men may familiarize themselves with them and for inspection, and the soda and acid extinguishers are checked up each six months.

Bituminous Mines

"It depends upon the type of equipment, but at bituminous mines the inspection ranges from no special attention to constant attention—in fact, at 18 mines the latter appears to be the rule. A majority inspects every week and a fair number twice a month and once a month. In some cases a weekly inspection is followed by monthly testing, and at others regular drill is held. It is important to keep hose in good condition. Fire extinguishers should receive attention every three or six months and be re-charged at least once a year. Of course rescue apparatus should be examined and tested frequently.

"One engineer writes:

"Rescue apparatus is in charge of two 'Rescue Superintendents,' whose sole duty is to look after apparatus and train crews. One attends to apparatus at three mines liable to gob fires and three gassy mines; the other looks after 15 gassy mines, but not liable to fires.

Metal Mines

"Practice at metal mines is similar to that at coal mines—from constant attention to weekly and monthly inspection and testing, according to importance of equipment.

QUESTION No. 5

"When sealing a fire, have you an established rule for sealing intake or return first, or both together? Give reasons briefly for your policy.

ANSWERS

Anthracite Mines

"Of five anthracite men, three have no set rule although two of them would seal the intake first, one would seal the return first, and one would seal both simultaneously, if possible, otherwise the return first. The reasons for sealing the intake first are these:

"(a) This will give fresh air for working and by placing the seal it cuts off the feed of fresh air to the fire.

"(b) Prefer sealing the intake first with an exhaust fan or the return with a pressure fan, and maintain the air current as long as possible.

"Two reasons for sealing the return first are:

"(a) This will cause the burned-out gases from the fire to form a layer of non-explosive gas directly over the fire, thus preventing a gas explosion.

"(b) By sealing the return first the firedamp is rendered inert by the gases produced by the fire.

Bituminous Mines

"While a number (20) of bituminous operators have no established rule for sealing and are guided by conditions, the remainder have fairly definite procedure, as follows: 17 seal the intake first, six seal the return first, and 15 seal both at the same time. A few quoted replies may be given as to why certain procedure is followed:

Sealing Intake First.

"(a) My plan has always been to seal intakes first. This allows men to work in fresh air. I first short the air just outby where I intend to put seals. Temporary seals are built in the intake and then a lead curtain is run up to where I am sealing returns. While I am making the intake seal air-tight I put up the seal in the returns and then make both seals air-tight.

"(b) My practice has been to seal off the intake first. Sufficient air should, however, be allowed to circulate the fire area to assure the combustion of the explosive gases generated.

"(c) We have an established rule in sealing the intake first * * * *. It is very necessary to get the intake air sealed off in the best manner possible, and to do this we can work under better conditions by leaving the return open. We also believe that from a safety standpoint it is preferable to leave the return open until the last * * * *.

(d) I have always sealed the intake first. By doing this the volume of smoke and gas in the return is greatly reduced, making it much easier to put in seals.

"(e) I favor sealing the intake first. In fact, if the fire has gained any headway you can seldom get on the return side unless you use apparatus, and then you cannot see. As soon as the intake is sealed you can generally get to the outlet side, as the heat from the fire works somewhat as suction, thus allowing you a chance at least to get in a temporary stopping which can be reinforced with proper material.

"(f) I always seal the intake first, the only safe and sane way of doing it. The ventilating current is first short-circuited outby of where the seals are to be erected and away from the fire. Of course one must be careful that there is no gas standing or being liberated to be carried over the fire zone. I feel safe as long as the fire is burning—that is to say, while there is flame which will consume the gases being generated. As soon as the intakes are closed off the gas will no longer be able to obtain enough oxygen to cause an explosion. Then the smoke and gases simply fill up all entries, and back out of the return until it is sealed.

"(g) Our general rule is to seal intake first, but work is usually begun on both stoppings simultaneously, if possible, preference however, in such being given the intake. The reason is that there may be a crack in panel barriers (coal beds are thick and fires occur in panel drawing) and our object is to prevent a 'draw' of fresh air across the fire at the latest possible moment.

"The consensus of opinion is that sealing the intake first is preferable, easier, and safer than sealing the return first.

Sealing Return First.

"(a) When practicable, the return should be sealed first. By doing so you keep the pressure constant without changing its direction until ready to seal the intake.

"(b) By sealing off the return side the smoke would be backed up onto the fire and render non-explosive any accumulation of gas that might take place.

"The general opinion seems to be that when the return is sealed first there is a tendency for carbon dioxide to be generated which would aid in extinguishing the fire.

Sealing Intake and Return Together.

"(a) If a fire was at the face of entries that were generating explosive gas I would try to seal both intake and return simultaneously. If I could not do this I would seal the return first. If no explosive gas was being generated I would seal whichever side was most convenient, first.

"(b) We seal both entries together. That allows us to keep the ventilation going steadily and it allows us to take care of the gas. Then we seal them both at once and get out of the mine on a motor.

"(c) I generally seal the intake and return at the same time. If I have opportunity and the face is not giving off too much methane, I seal the return first.

"(d) The only practical method is to seal up both intake and return whenever possible simultaneously, with the intake in the lead.

"A majority of those who favor sealing both entries at once would have the intake seal somewhat ahead of the return seal, but both would be finished together. One engineer would scatter rock dust liberally as close to the fire as possible.

"To show how opinion is divided, and decidedly, the following answer may be quoted:

"Generally speaking, the return should be sealed first in the event of a fire in a gaseous mine. It is positively dangerous to seal the inlet first, or the inlet and return at the same time. Many serious and fatal explosions have occurred through erecting both stoppings at the same time, or sealing the inlet first. Successful sealing of fires in gaseous mines depends absolutely on the experience and ingenuity of the superintendent, otherwise disaster is likely.

British Practice.

"The modern practice is to seal the intake and return simultaneously. Stoppings are built in both roads and a hole, which is fitted with a wooden door, is left in each stopping. When the stoppings are completed, both doors are shut and everybody clears out.

General Procedure.

"The following general statement covers gassy or non-gassy conditions:

"If there is no gas present, the intake and return should be sealed at the same time. If the smoke is very bad, the intake should be sealed first. This greatly reduces the difficulties in sealing the return if gas is present. Preparations should be made to close both intake and return after the men have left the mine, either by a long cable or a balance weight with a carbide can on one side with water in it, and a plug in the bottom which will permit the weight to release itself gradually. The permanent seals can be started 24 hours later.

Metal Mines

"No set rule seems to be applicable to metal mines, although most engineers recommend sealing the intake first. Two engineers do this and maintain a normal air current through the remainder of the mine if possible, thus making it possible to work in fresh air in getting ready to fight the fire. One also believes that forced ventilation is very necessary to fight a fire quickly and safely.

QUESTION NO. 6

"What is your practice with regard to the position of seals with respect to their distance from the fire, assuming that conditions are such that the same number of stoppings will make the seals, whether placed right at the fire or any distance back to 1,000 *feet?*

ANSWERS

Anthracite Mines

"The replies to this question were unanimous, and to this effect: If the fire is in a non-gassy area, seal as close thereto as possible, but if gassy, seal as far off as practicable—1,000 feet or more. One engineer says:

"Seal as close to the fire as possible on the intake side, and the return seal back 100 feet or more from the intake seal for the purpose of examination.

Bituminous Mines

"Bituminous operators answered in this way: Twenty-eight would seal as close as possible, irrespective of gas; 10 would seal as far as possible, up to 1,000 feet, whether the mine is gassy or not; 10 would seal close if non-gassy and at a distance if gassy; and eight would seal at a reasonable distance in any case—200 to 500 feet away.

"A few reasons may be quoted:

Sealing as Close as Possible, Gas or No Gas.

"(a) We always seal our fires as near as possible because we find that they die quicker for the reason that they have a smaller body of oxygen to consume than if a large area were sealed.

"(b) Place the seals close to the fire, if possible, and start the smothering in the least possible amount of air.

"(c) I seal as close to the fire as possible. I disagree with the man who contends that a seal should be placed at a considerable distance from the fire. Such procedure gives the fire more fuel and requires a longer period to smother it, and this increases the danger from explosion while the fire is being sealed or after.

"(d) We prefer to limit the fire zone as much as possible so as to cut down the amount of oxygen therein.

Sealing as Far as Possible.

"(a) In my opinion it is not relatively safe to seal too close if gas is being generated in close proximity to the seat of the fire. Presumably the gases generated will have greater room for expansion if the seals are placed say from 300 to 1,000 feet distant. How-

Fig. 1, Mr. Ryan's Paper.—Breathing apparatus crew erecting temporary seal

ever, it appears that all mine fires have a peculiarity of acting differently.

"(b) This is difficult to decide on paper; local conditions are the deciding factor. The first essential is to select a place where room and floor conditions permit the erection of substantial seals. I do not think it safe procedure to seal close to an active fire; especially if considerable gas is emitted.

"Two entirely reverse opinions to those just quoted are as follows:

"(a) If gas is being liberated near the fire, the seals should be made as close as possible, but ventilation should be kept going and the fire should be maintained until it is possible to close the intake and return simultaneously. In the absence of gas a greater distance is permissible, although the oxygen content is reduced quicker in a small area.

"(b) If gaseous, keep as close to the fire as possible, but do not build seals; build doors that can be closed when all men are out of the mine. If not gaseous, there is no material difference.

Sealing Close if No Gas, and Distant if Gas Present.

"(a) Where gas is not given off, stoppings can be placed approximately 100 feet from the fire, provided that the roof is good and there is room for expansion of gases in case of falls. In case the fire area is making gas freely, the seals should not be closer than 300 feet in order that the fire may consume the oxygen before an explosive mixture is generated.

"(b) When mines are not gassy I tried to place the stoppings as close as possible. In gassy mines I would erect the stoppings 300 to 1,000 feet from the fire. The distance would depend upon the amount of inflammable gas being made; the more gas the farther back should be the seals, particularly on the return side.

British Practice.

"If the fire is small and there is not much flame, and the seam is not fiery, then the stoppings should be placed close to the scene of the fire. If the fire is large and the seam is fiery, and particularly if preliminary explosions have taken place, then the stoppings should be placed at least 900 feet back from the scene of the fire. It is important that the roadways between the stoppings and the scene of the fire should be thickly coated with stone dust so that any explosion which occurs around the fire will not be propagated by coal dust. One of the most important points in fixing the site of stoppings is that they should be near a source of fresh air but isolated from this fresh air.

Metal Mines

"Naturally enough, at metal mines the procedure is to seal as close to the fire as possible. Of course the ground must be sound and there must not be any timber nearby.

QUESTION No. 7

"Do you take into account the amount of gas being generated near the fire when deciding on the position of your seals?

ANSWERS

Anthracite Mines

"At three anthracite mines questioned they do consider the gas being generated near the fire before deciding where to erect seals. At a fourth it is not considered in regard to the intake seal, but the gas will be a factor in placing the return seal. One engineer states that:

"The amount of gas generated does not control the position of the seals. The amount of gas generated should be considered in connection with the size of the fire. There is always a race between the firedamp and the inert gas. When firedamp is generated freely the fire should be large enough to generate sufficient inert gases to prevent an explosive mixture.

Bituminous Mines

"Virtually without qualification, 48 bituminous engineers take the gas being generated into account before sealing. Some of them consider it of great importance. One engineer would not seal up a burning feeder of gas but would extinguish it by water, wet canvas, or shale dust, and then seal, if necessary. Eight engineers don't consider the effect of the gas before sealing.

Metal Mines

"In metal mines only the gas being generated by the fire has to be considered, yet the majority of the answers to this question showed that this gas is taken into account.

QUESTION No. 8

"Do you recommend having material on hand in certain sections of gassy mines subject to high fire hazard for use in quick building of temporary seals and to be kept for that purpose only? If so, give briefly a list of material you would recommend for this purpose?

ANSWERS

Anthracite Mines

"One answer to this question is:

"This might be a good thing in bituminous mines but it is never thought of in an anthracite mine.

"Yet the other four engineers recommend that such material as brattice boards and cloth, nails, tile, cement, sand, and tools be available. One answer says:

"All necessary material for fire-fighting is kept on hand for normal control of ventilation.

Bituminous Mines

"Eighty-five percent of the bituminous operators answering this question favor the practice of having supplies in the mine for temporary seals, but several do not approve of temporary seals. The remainder think that the usual supplies at a mine suffice and can be taken inside if necessary.

"The list of materials given ranges from a few things such as brattice cloth, gas masks, 1 by 12-in. boards, 2 by 4-in. lumber, and clay (the materials commonly at hand) to a list of 13 items ready boxed and ready for quick transportation to any point where they might be needed. At one group of mines, each section of a mine has material stored and the penalty for removing this for other than fires is dismissal. One engineer writes:

"It is not in my recollection that I have ever seen a mine where probable fire conditions were so serious as to demand that materials be kept ready. It would be more practical to use extra preventative precautions rather than keep sealing material on hand.

Metal Mines

"Three groups of metal mines recommend that a few supplies be held in readiness; one keeps canvas, light lumber, nails, and tools on the surface; and the fifth always has supplies available and gunite machines for constructing stoppings.

QUESTION No. 9

"In sealing fires, what do you recommend for the temporary seal? (See Figure 1).

ANSWERS

Anthracite Mines

"Brattice boards and brattice cloth, and clay, appear to be the popular materials for temporary seals at anthracite mines. A double thickness of canvas on posts and ship-lap frame is recommended for speed, and canvas between the two

layers of ship-lap for better construction. Sound advice is given as follows:

"Seals should never be erected gradually, such as one board at a time.

Bituminous Mines

"The best way to summarize these answers is to list the materials commonly used: Boards (double) with sand or clay between boards (inch thick) plastered; brattice cloth (nonflammable); canvas on posts or several plies or reinforced with boards; laths on frame and plastered; matched lumber; ship-lap; wire netting plastered; wood fiber; wood stoppings well mudded. It would seem that brattice cloth or canvas and light lumber are the more favored materials. The steps recommended by two engineers are: first, canvas or board and canvas; second, solid boards; and third, brick. One engineer would use anything convenient, noncombustible preferred.

Metal Mines

"Brattice cloth and boards are recommended for metal mines. One reply may be quoted:

"I strongly believe in having well-constructed frames built at critical points to which brattice cloth or boards could be quickly nailed. For quick work, brattice cloth could be used, later followed by boards and wood fiber plaster or even gunite or stucco to make a real tight job.

QUESTION NO. 10

"Do you recommend starting the permanent seals immediately upon completion of temporary seals, or do you advocate removing all men from the mine for a certain period upon completion of the temporary seals?

ANSWERS

Anthracite Mines

"This question was answered in several ways, but these two citations cover them all:

"(a) If temporary seals are fairly airtight, I would remove the men for 12 hours before starting on the permanent seals.

"(b) Remove all men, other than officials, from the mine immediately on discovery of fire. Whether you would remove men before placing permanent seals would depend upon an indefinite time factor, this being the probable period to develop an explosive mixture within the seals.

Bituminous Mines

"In this case, 14 engineers would build the permanent seals at once; that is, following the temporary seals. Some would not bother to make the temporary seals airtight and some would not put up temporary stoppings. Eight engineers would order all men out of the mine as soon as the outbreak of fire was discovered; 12 would be guided by the conditions of gas; and 24 advocated removing the men for 3 to 36 hours after the temporary seals were built.

Metal Mines

"As there is no danger of explosive gas in a metal mine, the problem is much more simple than in a coal mine, and once sealed up and under control, even by a temporary seal, men may go about their work as usual. One engineer would substitute permanent seals for temporary ones as soon as possible.

QUESTION NO. 11

"What material do you use for permanent seals?

ANSWERS

Anthracite Mines

"Only one operator would use props, planks, and clay; the others use concrete, brick or cement gunite.

Bituminous Mines

"While two engineers would use the 'most convenient incombustible material,' eight others recommend board stoppings plastered, some with double walls filled in with sand or clay. The majority favor brick laid in cement mortar, brick and tile, and brick or concrete. A number recommend concrete—either mixed at the place or as ready-made blocks, in one case of coke breeze and cement 8 by 16 inches in size. Gob material and material from a 'middle rock' in the coal bed are used at two mines. The stoppings should be well hitched in sides, top, and bottom of coal.

Metal Mines

"Concrete is most favored in metal mines, then brick; although board stoppings and plaster are considered sufficient for most cases.

QUESTION NO. 12

"Have you employed rescue apparatus in sealing fires, and to what advantage?

ANSWERS

Anthracite Mines

"Of five answers to this question, two had not used apparatus, two had, and one had little experience with them. One considers them a necessity, especially if air-locks are used.

Bituminous Mines

"Under this head we have such a range of answers as these: Yes, 45; no, 7; little experience, 2. The following observations may be quoted:

"(a) It has never been necessary here to use rescue apparatus in connection with fire.

"(b) Rescue apparatus has been used to considerable advantage (several answers).

"(c) Yes, at the Horning mine the work could not have been carried on as it was had apparatus not been used. Stoppings were erected by crews wearing apparatus in as short a time as without them. In a number of other cases, fires could not have been controlled or sections explored without their use, and thereby saving life and property.

"(d) Most emphatically, yes—in fact, three-fourths of the mine fires that I have fought during the last 16 years could not have been fought successfully without the use of artificial breathing apparatus. If this equipment had done nothing else than help the mine fire, it has saved many thousands of dollars in preventing loss of property and loss of wages.

"(e) Breathing apparatus and gas masks should be available for immediate call. Such equipment is indispensable when sealing the return, and occasionally the intake when ventilation is interrupted.

Metal Mines

"All have employed apparatus in metal mines—one slightly. Here is a record of one engineer, who states that it would have been impossible to do the work without breathing apparatus: 16 concrete bulkheads in a copper mine; 4 bulkheads in each of two gold mines; and 3 bulkheads in a lead-silver mine.

QUESTION NO. 13

"Have you used carbon-monoxide gas masks as respiratory protection while sealing fires? If so, to what advantage? (See Figure 2.)

ANSWERS

Anthracite Mines

"Three of five engineers have used gas masks while sealing fires and found them satisfactory. A lot of work can be done in a short time, they are more comfortable than breathing apparatus, and more suitable, where feasible to use them.

Bituminous Mines

"The replies from bituminous mines were: 28 had used gas masks and 26 had not, but several of the latter had made observations and believed that their use would be of value. Five of those that use gas masks only do so when a flame safety lamp burns (one also uses a carbon-monoxide detector), which is the right thing to do, as the gas mask is only approved by the Bureau of Mines under that condition. One engineer prefers breathing apparatus. Several answers may be quoted:

"(a) I have used carbon-monoxide gas masks to the same advantage that I have used breathing apparatus.

"(b) Men can get closer to the fire zone and work quicker with gas masks than with breathing apparatus. No special training is required to use gas masks effectively, therefore more help is available.

"(c) In a mine where we had nine different fires burning at the same time, the worst fire I ever saw, we used carbon-monoxide gas masks. I consider the mask to a great extent responsible for our success.

"(d) I would use gas masks on the return side, keeping oxygen breathing apparatus in reserve.

"(e) Although I have never used carbon-monoxide gas masks for fire-fighting purposes, I am convinced that there are many mine fires where their use would be valuable. Of course, it must be remembered that they have their limitations and are not the equal of breathing apparatus for meeting all conditions surrounding mine fires and explosions.

"(f) The first use of carbon-monoxide gas masks was at the High Coal mine of the Anchor Coal Co. in 1921. I have used them continually since. It is impossible to seal some fires without them.

Metal Mines

"None of the metal-mining engineers have used gas masks, although at one central rescue station they have a set of five available.

QUESTION NO. 14

"Have you had experience with using rock dust for fighting fires direct?

ANSWER

"Excepting at two mines where a supply is kept on hand, and one engineer who has used sand and another who used rock dust experimentally, and several believe that it would be of value, the general answer is that none have had experience in using rock dust for fighting fires direct.

QUESTION NO. 15

"In determining the position for your seals, do you take into account whether the fan is acting as blower or exhaust, or do you think this has an influence which would affect location or the order of erecting the seals?

Fig. 2, Mr. Ryan's Paper.—A properly equipped gas-mask crew

ANSWERS

Anthracite Mines

"There does not appear to be any set rule for the relation of position of seals and operation of the fan. One engineer prefers sealing the intake first with an exhaust fan or the return with a pressure fan, maintaining the air current as long as possible.

Bituminous Mines

"Nine engineers believe that the operation of the fan has a bearing on the position of the seals and take it into account before sealing. On the other hand, 37 others reply definitely that they can not see what influence the fan has. Four consider that a fan should be reversible to aid in sealing. One of these may be quoted:

"(a) I favor having the fan working as a blower when building fire seals because you are generally on the inlet side. I have had the fan reversed at times to get this effect until I got the intake seal placed. As a rule, you can short-circuit your air if you are working on the intake side, but if your fan is working as an exhaust over the fire you are ventilating it until your inlet seal is complete.

"In an answer to the contrary—that the fan has no influence—it is stated:

"(b) It is the question of direction of the air current near the fire that is the important factor. It would be highly dangerous to change the direction of the air current unless all men withdrew.

"*British Practice.*—Fans in this country are invariably exhausting. The main point with regard to ventilation and the position of the seals is that the water gage should be kept as low as possible where the seals are being erected, and, secondly every attempt must be made to equalize the pressure on both sides of the stoppings. It is, of course, realized that with the rise and fall of the barometer the stoppings will breathe but if the air pressure difference between the stoppings is as low as possible the risk of fresh air leaking into the sealed-off air is reduced to a minimum.

Metal Mines

"Opinion is divided at metal mines. At one group of mines the fans are always working as blowers; in another district the fans are shut down on the outbreak of fire and portable fans are operated while seals are being built; and at two other groups the fire area is usually put under pressure to keep gases back in the fire area, and seals are placed at the most convenient place.

QUESTION NO. 16

"When erecting the permanent seals, do you provide a pipe or valve for taking gas samples and for recording and relieving pressure?

ANSWER

"Only 1 of 67 anthracite, bituminous, and metal mine engineers does not place a pipe and valve in seals—not necessarily in all seals. The size of pipe ranges from ½ inch to 3 inches in diameter with various types of valves and other gages. In one case no valve is used, only a piece of canvas over the end of the pipe; this is loose or tight, according to whether there is pressure or suction in the sealed area. One engineer attaches a relief valve to the pipes in seals, and another believes 'it is a big mistake.'

QUESTION NO. 17

"Do you have any fixed rule as to length of time a section should be sealed before it is reopened? What factors do you take into account in deciding when to reopen?

ANSWER

"With the exception of a few that have no fixed rule, the practice at the majority of anthracite, bituminous, and metal mines is to be guided by the analyses of samples of the atmospheres taken from the pipes and valves in seals. At some mines the temperature is also taken. After the oxygen and carbon monoxide are virtually at zero, or the oxygen is constantly low, say 2 or 3 percent, and carbon monoxide is absent at least a week with a small fire and a month with a large fire should elapse before steps are taken to reopen the sealed area. At one group of mines the panels are left sealed for six months, and sometimes a year.

QUESTION NO. 18

"Do you explore a sealed section with a rescue crew before reventilating?

ANSWER

"Eighty percent of the answers to this question showed that the exploration of a sealed section with a rescue crew before reventilating is good procedure. Several engineers do not or have not found it necessary to do this. Two answers, (a) partly favoring the practice and (b) definitely no, are as follows:

"(a) In six years I have only explored one fire before opening. As a rule I know that my fire is out by the analyses and make sure that it stands long enough below 2 percent oxygen before I will open it. With this system I have never found fire after opening the seals, and it is much safer.

"(b) No; it is not necessary to risk life, if samples taken show less than 3 percent oxygen and sufficient air can be put in to sweep the place clear in a few hours, as spontaneous fires take hours to blaze or rekindle. I have never had one come to fire under 48 hours.

QUESTION NO. 19

"When building permanent seals, do you provide a door built in one of the seals for purposes of later exploration? If so, what size and what material?

ANSWER

Anthracite Mines

"In the anthracite region the practice varies from solid seals to an air-lock with doors 2 by 3 feet of match lumber, and to a 24-inch flange of pipe with an air-tight blank bolted on the outside end.

Bituminous Mines

"Practice in bituminous mines also varies. A few build solid seals; several erect seals with a 2-foot square hole sealed with brick or tile so that after a temporary seal has been built outby, the brick or tile may be knocked out and the fire area entered; several build air-locks; and less operators build seals with doors in them than those that do not.

"One reason for not providing for a door is that it takes too long to seal; another is that leaks are possible.

"As to the material used in doors in seals, wood is mostly used. One engineer recommends wooden doors in wooden seals and steel in tile seals. As to size of doors, they vary from 18 by 24 to 30 by 54 inches, with 24 by 24 or 30 by 30 inches most favored. Some engineers are guided as to size by the space required by a crew wearing breathing apparatus.

Metal Mines

"Opinion of metal miners is unanimous. Doors of iron or steel, 24 by 36 to 24 by 60 inches, and clayed or gunited, are fitted in seals. In one group of mines a means is arranged for entering every sealed section.

QUESTION NO. 20

"In a bituminous coal mine having an explosive dust, do you advocate rock dusting the entries outby the seals either by spraying or barriers?

ANSWER

"The general answer to this question is that 83 percent are in favor of rock dusting the entries outby the seals both

by spraying and barriers. A few would spray the dust and a few would sprinkle water. One answer is:

"'The entries should have been rock dusted before the explosion';
"and another is:

"'I would blow heavily 10 pounds of dust per linear foot of entry and have 16 V-trough barriers loaded up to the fullest possible capacity.

"Another answer, from a British engineer, is:

"'Yes. It is absolutely essential that all the roads in the vicinity of the fire should be thickly coated with stone dust, and also all the roads in the vicinity of the stoppings similarly treated. This is the first precaution and possibly the most important one to be taken.'

QUESTION NO. 21

"Have you experienced any explosions occurring while sealing a fire or after the seals were completed? If so, state briefly the conditions at the time of explosion.

ANSWERS

"None of the anthracite men have personally experienced any explosions while sealing, although they cite several occurrences. Naturally, more or less, none of the metal mines have had such an affair. About half of the bituminous men have not experienced any explosions and nearly a third actually have. Pitching coal beds seem to be susceptible to such explosions. Some excerpts are as follows:

Anthracite Mines

"(a) At one colliery two explosions took place after the stoppings had been erected. In these cases I believe that the fire was too small to generate sufficient gases to render the firedamp inexplosive. In other words, the firedamp won the race.

"(b) At another colliery an explosion took place while the workmen were preparing to erect the seals. At the time forms of about 12 inches were being erected around both the intake and return airways. The form on the intake was about finished when the explosion took place. The work was being done at a safe distance from the fire and nobody was hurt. It is believed that the volume of air entering the section was reduced because the airway was becoming congested through the number of men engaged at the form.

Bituminous Mines

"(a) We have experienced explosions while sealing a fire and after the seals were completed, as the seals were not erected in their proper order. One explosion practically destroyed a section of the mine. It tore out timber, steel supports, reinforced-concrete bridges, coal pillars, and set back the water gage 2 inches on the exhaust fan in a shaft 930 feet deep situated a half-mile from the nearest seal. This explosion blew debris 200 feet into the air on top of the shaft.

"(b) A few years ago in one mine several explosions took place immediately after and while sealing, and killed four men. This is a pitching coal bed, about 55 degrees. I believe that a fire was burning in room pillars with a gas feeder or feeders at the face of rooms. Every time the gas accumulated sufficiently to come in contact with the fire an explosion occurred. This mine was sealed at the entrance and abandoned permanently.

"(c) Some well-known cases of explosions during sealing or reopening after the seals were broken: (1) Vulcan mine, New Castle, Colorado, 1918, 3 killed while rebuilding blown-out seals; (2) Piper mine, Piper, Alabama, 1925, 6 killed while reventilating after seals were broken; (3) Rockwood mine, Rockwood, Tennessee, 1925, 10 killed while attempting to recover section after seals were broken; and (4) Pittsburgh Terminal No. 3 mine, Horning, Pennsylvania, 1926, 20 killed while seals were being built.

"(d) At the time of sealing the High Coal mine of the Anchor Coal Co., explosions took place every six minutes. This period lengthened as seals were completed. Four 4-inch valves were kept open for 12 hours after the seals were placed, then gradually closed.

"(e) We were sealing a mine fire that was burning in a caved panel. We could not see it, but there had been two slight explosions. We were just completing the erection of wood seals when another slight explosion occurred, just enough to topple the seals over without breaking them. We did not think that much harm had resulted, but three of the men died later from burns. This fire originated from opening a flame safety lamp to demonstrate that there was no gas present on top of the fall in this abandoned panel. Gases ignited and the flame traveled back into the panel, resulting in the fire.

"(f) I am lucky enough not to have had any serious experience of this sort. I have been present when small explosions have occurred in the region of a fire which were noticeable by a sudden rush of air. Had the roads (inby) which we were working not been adequately stone dusted, in all probability I should not be writing this. Several instances have occurred of explosions occurring when sealing off fires. They usually happen as the supply of air is being cut down, just before the stoppings are being sealed off. Hence my statement that we nowadays use wooden doors which are closed at the last moment. When building off a fire we allow sufficient air to pass over the fire to keep the percentage of inflammable gas below the explosive limit. Then, when the stoppings are completed, the doors are closed.

QUESTION NO. 22

"The following pertinent question was asked and answered by one engineer who answered all of the others:

"What provision is made for handling water that may accumulate behind fire seals?

"Consideration must be given in sealing a fire area to the water behind the seals. In a great many cases this can be done by opening the valve on a line already in place provided the dip is not too great. Otherwise, a special pipe must be put through the stopping either before building the seal or after the seal has been made.

"Two principles are involved: One is a U-pipe which will be self-sealing and will work automatically; the other is to use a pipe with a valve which must be handled by a pumpman.

SUMMARY OF ANSWERS TO QUESTIONNAIRE

"Naturally enough, in a group of 5 anthracite (one of the bituminous men also answered for anthracite mines), 55 bituminous, and 7 metal-mining engineers (two of the bituminous men also answered for metal mines), there would be found a diversity of personal opinion, mostly based on varied conditions. However, the 21 questions asked and 1,408 answers given may be summarized as follows:

"1. *Fighting fires direct or sealing at once.*—The general practice is to fight direct, if the fire hasn't got beyond control and there is no apparent risk of explosion or other trouble.

"2. *Fire-fighting equipment readily available in the mine.*—In almost every case some type of equipment or apparatus is kept on hand for fighting fires direct.

"3. *Fire-fighting equipment readily available on the surface.*—In general, what is kept outside is additional and supplementary to that already inside the mine.

"4. *Inspection of fire-fighting equipment.*—It depends upon the type of equipment, but the practice ranges from no special inspection to regular or constant attention and testing.

"5. *Sealing intake or return first or both together.*—Less than half of the engineers replied that they have no set rules; they would be guided by conditions and either the intake, return, or both, would be sealed. Those engineers that have fairly definite procedure represent 58 percent of the total, and of these 45 percent seal the intake first, 16 percent seal the return first, and 39 percent seal both at the same time.

"6. *Distance seals are built from the fire.*—Opinion varied considerably regarding this problem: Nearly half would seal as close as possible, irrespective of gas; the remainder, equally divided, would seal as far as possible, whether the mine is gassy or not; would seal close if nongassy and at a distance if gassy; and would seal at a reasonable distance in any case.

"7. *Influence of gas on decision as to place for sealing.*—Virtually without qualification, about 80 percent of the engineers take the gas being generated into account before sealing.

"8. *Material available in gassy mines for building temporary seals.*—More than 80 percent keep suitable material readily available.

"9. *Material recommended for temporary seals.*—The most popular and practical material appears to be brattice boards and brattice cloth, posts, clay, or some kind of plaster.

"10. *Time for erecting permanent seals and removal of workmen.*—About one-third of those replying would build permanent seals at once; that is, following the temporary seals. Some would not put up temporary stoppings. One-third advocated removing the men for 3 to 36 hours after building the temporary seals.

"11. *Material for permanent seals.*—While a few recommended board stoppings plastered, some with double walls filled in with sand or clay, the majority favor brick laid in cement mortar, brick and tile, and brick or concrete.

"12. *Use and value of rescue apparatus in sealing fires.*—Fully 80 percent of the answers stated that rescue apparatus had been used, and to advantage; 15 percent of the engineers had no experience with them.

"13. *Use and value of carbon-monoxide gas masks in sealing fires.*—A few more than half replied that they had used gas masks to advantage and the others had not used them, although several of the latter believed them to be of value.

"14. *Use of rock dust in fighting fires.*—The general answer is that none

have had experience in using rock dust for this purpose. Two men had used it to good advantage.

"15. *Influence of direction of ventilating current on place for seals.*—More than half of the engineers can not see that this has any bearing on the problem; about 15 percent do; others have no set rule.

"16. *Placing pipe or valve in permanent seals for sampling, etc.*—The unanimous reply (only one exception) is that this is done.

"17. *Period the fire area should remain sealed.*—Excepting a few mines, there is no fixed rule; the analyses of samples of the atmosphere behind the seals control when they should be broken.

"18. *Exploring sealed sections with rescue crew before reventilation.*—Eighty percent of the replies showed that this is good practice; several do not or have not found it necessary.

"19. *Door in permanent seals.*—The practice varies, but the majority provide a door or a place for a door when erecting seals.

"20. *Rock dusting entries outby seals.*—About 80 percent are in favor of doing this.

"21. *Explosions while sealing fires.*—No anthracite or metal mining engineers have experienced explosions while sealing fires, but about a third of the bituminous coal engineers have.

"22. *Water accumulating behind seals.*—Water behind seals should be taken into account and provision made for pipe and valve of some type when the seals are built.

Conclusions of the Writer of this Paper

"The object of the foregoing questionnaire was to ascertain the general practice in combatting mine fires in various districts of the United States, Canada, and Great Britain, embracing bituminous, anthracite, and metal mines; and more particularly to point out the hazard to life in fighting and sealing a fire in a bituminous coal mine generating explosive gas and having a flammable dust, because in the writer's opinion this is the most hazardous fire to combat on account of both the gas and dust explosion hazards. It is true that all fires are hazardous, but the primary object of this paper has reference to the explosion hazard connected with fighting and sealing fires in a gassy mine.

"All mine fires are liable to generate some combustible gases, but the probability of an underground fire, itself, generating sufficient combustible gases to cause other than a slight explosion is extremely slight.

"The great hazard, therefore, is methane liberated in the mine, and the amount of methane that the mine generates should be known through experience prior to the fire and taken into consideration as well as the position of the fire with respect to where the methane is being given off, and both should be given serious consideration in the plan of procedure.

"If in a gaseous mine the fire is in a large developed section from which the gas has bled off, and it can be surrounded with seals and the ventilation directed to keep the gas liberated in the advanced sections away from the fire area, there is little more hazard from sealing than in a nongassy mine.

"The greatest explosion hazard is when the fire is at the face or near the face of a section that is liberating a considerable quantity of methane.

"The procedure for handling such a fire is the point where the questionnaire develops that there is the greatest difference of opinion, and it is hard to determine just what the present practice is, which is unfortunate.

"A fire under these conditions should be fought direct until every means is exhausted before resorting to sealing because there is less hazard, other than a slight explosion, while fighting the fire if the ventilation is properly controlled than there would be in sealing.

"This means that a fire such as this should be anticipated and every mine should have on hand at all times sufficient fire-fighting equipment similar to the list proposed by the Smoke Eaters' Association previously mentioned. The answers to the questionnaire show that this is the case with most large companies.

"If conditions are such that it becomes necessary to seal the fire only as a last resort, then consideration should be given to the dust-explosion hazard, because a slight gas explosion might cause a dust explosion and a catastrophe. On account of this possibility all of the men excepting those directly engaged in the fire work should be removed from the mine and any connecting mine while the fire is being fought or sealed, if the dust has not been rendered immune by rock dusting or watering.

"Before the sealing operation is commenced, if rock dust is available, by all means distribute it plentifully inby the seals for protection against propagation by dust.

"Now comes the point concerning which there is the greatest difference of opinion among mining men; namely, shall the intake or the return be sealed first or both simultaneously? The adherence to erecting the return-side stopping first are numerous and the case is ably presented in J. J. Walsh's book, 'Physics and Chemistry of Mining and Mine Ventilation,' in paragraph 123, dealing with mine fires, as follows:

"'In gaseous mines the return stopping should be erected first. If the stopping on the intake side of a fire is put up first, a partial vacuum created by the ventilating equipment then exists in the enclosed area and the gases generated by the fire are drawn away from it, likewise any firedamp that might be on the intake will move in the direction of the fire, and an explosion will likely result.'

"The writer of this present paper gives full credit to the merits of these arguments, but still remains an adherent of sealing the intake first, or preferably both simultaneously, if it can be done with dispatch.

"Sealing the fire under the conditions as outlined resolves itself into a race rather than a problem, a race to have the fire deplete the oxygen before the combustible gases can accumulate to the point of an explosive mixture, and in this connection the law of the diffusion of gases must be taken into consideration. At the moment of sealing it is better to have a good-sized fire than a small one, because when the air is cut off the oxygen will be depleted more rapidly. By erecting both seals simultaneously, or the intake first, the oxygen is depleted more quickly than if the return stopping is erected first, and the intake stopping can usually be erected more quickly. Almost instantly on cutting off the air there is a reduction of the explosion hazard, by reducing the oxygen content and increasing the carbon dioxide, both of which lower the explosive range of methane. According to H. F. Coward and F. J. Hartwell, in Paper No. 19, 1926, of the British Mines Department, when the oxygen is reduced to 15 percent and 5 percent of carbon dioxide is present, the explosion range of methane is changed from 5.2-14 percent to 5.6-8.1 percent; when the oxygen is further reduced to 14 percent and with 6 percent carbon dioxide present, the explosive range of methane is changed to 5.8-7.0 percent, and when the oxygen is reduced to 13 percent with the amount of carbon dioxide present that would likely result from this depletion, an explosion could not occur. Any further increase in the methane content might be considered an inert gas and speed up the oxygen decrease by air exchange through building up positive pressure that would force out oxygen through the temporary seals, and it would be replaced by the now inert methane.

"The first seals erected should be temporary but fairly substantial, preferably of noncombustible materials but which can be quickly erected. As soon as they are completed, get to the outside as quickly as possible, and if you run you should not be criticized. The critical moment appears to be within a few hours after the air is taken off the fire, or during the time of the race between the oxygen going down and the methane going up, because if these two curves cross within the explosive curve there is bound to be an explosion, whose magnitude will depend upon the mixture and the volume.

"After 12 hours have elapsed and nothing has happened it is safe to return and build the permanent seals. This can be accomplished without much danger of an explosion, provided that enough air is directed against the temporary seals to dilute the gases that may be seeping out, and dilute them below the explosive limit.

"(Gas samples should be taken from the pipe in one of the temporary seals and these should be analyzed to learn the condition of the atmosphere back of the seals before starting work on the permanent stoppings.)

"The position of the seals with respect to their distance from the fire is another question that caused considerable difference of opinion in the questionnaire, and is usually a subject of much discussion at every case of sealing a mine fire. The advocates of erecting the seals at some distance from the fire—1,000 feet or more—base their arguments largely on (1) the larger area in which the gas can diffuse before it will accumulate to an explosive mixture; (2) to assure a reasonable degree of safety for the men working on the stoppings and decrease the disturbance at the stoppings in the case of a slight explosion at the fire; and (3) the reduction of the oxygen content through absorption by the coal.

"The writer believes that the smaller the area sealed the more rapidly will the oxygen be depleted below the explosive limit. This is the important factor, but due consideration must be given to the rapidity of the spread of the fire, as the writer knows of cases where the fire traveled back to the seals before they were completed and the men were driven back to a new position on account of the heat. Also, consideration must be given to the safety of the men and disturbance of the stoppings in case of a slight explosion.

"There was no great difference in opinion in the answers to the other questions, and a study of the summary of them will show a fairly general practice. They will not be commented upon further except to point out that if a fire started from the ignition of a feeder of gas, which in turn ignited the coal or other combustible matter, in fighting it do not extinguish the feeder flame until the remainder of the fire has been extinguished, because the feeder flame will consume most of the gas and prevent it accumulating, which might cause an explosion. This would be particularly hazardous if the fire could not be controlled and had to be sealed.

"Another caution regarding the procedure is ventilating the sealed area when attempting its recovery. This should be done very cautiously and air should not be directed over any part of the area before it has been explored, because the fire may be to all appearances extinguished but the heat may not have all been dissipated, and directing the fresh air on it might rekindle it and at the same time give a dilution that would make an explosive mixture.

"In conclusion, the writer wishes to emphasize that no fixed rule can be established to govern the handling of every mine fire in the same way, and each presents its own peculiar problems that can not be separated from its surroundings. There are, however, fundamental laws of physics and chemistry largely controlling the hazard and they should be carefully studied by all mining men. An ounce of prevention is worth a pound of cure, and every fire should be anticipated and adequate fire-fighting equipment should be available and considered as necessary insurance. At every mine the officials should be drilled in fire fighting; if the drill would consist of nothing more than an inspection of the fire-fighting equipment and the discussion of assumed fires in the various workings of their mines and how they would handle them.

"A fire is the most hazardous thing that can occur in a mine, and its size is not always a measure of the hazard and the consequence that may result.

"If this paper does nothing more than cause a discussion and direct attention to the problem, it will have amply repaid the time devoted by the contributors to the answers to the questionnaire and to whom I again wish to express gratitude for their generous response and cooperation.

CONTRIBUTORS TO QUESTIONNAIRE

"The following men, who are classified at the beginning of this paper, replied to the questionnaire:

"H. T. Bannister, I. N. Bayless, J. V. Berry, D. R. Blower, John L. Boardman, W. D. Brennan.

"W. H. Carrick.

"James Dalrymple, A. W. Dickinson, S. D. Dimmick, F. B. Dunbar, W. G. Duncan, B. W. Dyer.

"William Ferguson, J. J. Forbes, Allan French, Edward Flynn.

"J. A. Gould, Edward Graff.

"S. S. Hall, Daniel Harrington, C. A. Herbert, Walter Herd, Frank Hillman, Frank Horton.

"Lot H. Jenkins, T. E. Jenkins, John E. Jones, R. M. Lambie, William Lauder, Robert Lilly, Clyde Lutton.

"R. P. Maloney, Richard Maize, Robert McAllister, George S. McCaa, Patrick Mullen, B. J. Murphy.

"C. H. Nesbit, William Nisbet, F. B. Nold.

"John Ogilvie.

"D. J. Parker, J. W. Paul, Byron O. Pickard, G. T. Powell, M. W. Price.

"J. W. Reed, Wm. R. Reese, S. C. Reynolds, George S. Rice, George Riggs, J. A. S. Ritson, J. J. Rutledge.

"J. A. Saxe, James Sherwood, H. I. Smith, K. T. Sparks, Edward Steidle, John T. Stirling, Robert Strachan, J. E. Struble, E. H. Suender.

"J. J. Walsh, Henry Walker (not received in time to be used), A. C. Watts, George W. Wilkinson, Orr Woodburn."

CHAS. H. NESBIT. *Chief Inspector of Mines, Birmingham, Ala.:*

"It is the desire of the writer in preparing this paper to treat the subject in as brief and comprehensive a manner as possible and bring out in a clear way the most essential points, with a view of reaching the average mining man—who should thoroughly understand the importance of dealing with the most hazardous problem known to the mining industry—and impressing upon him the serious obligation to be assumed by those whose duty it is to perform such tasks.

"Let us consider first of all the welfare of the employes, then the conservation of the property. Therefore when a fire is discovered in a mine of this character all employes except those whose services are needed for fighting the fire should be ordered to the surface immediately and all preparations made in the quickest possible way to start the work of controlling the fire. Every known means consistent with safety should be exhausted to extinguish the flame before sealing is considered—which should be the last resort—for, as the old miners used to say, 'Fight, and fight till you can't fight no longer, then bottle her up, and the cork may blow out.'

"All preliminaries should be carefully mapped out and orders given only by competent persons directing the work.

"In the event it has not been done, that part of the mine in the vicinity of the fire should be thoroughly rock dusted or washed down and made wet, to preclude the possibility of extending an explosion; then the work of erecting temporary seals should be started and rushed to completion. The intake should be sealed first, then the return. The seals may be built of boards and framing of suitable sizes, or by using brattice cloth where it is found necessary, the idea being to make a tight stopping. In all cases the seals should be placed as close to the fire as possible. This is important in order to reduce the area in the zone to the smallest amount of space, thereby leaving as little room as possible to be occupied by oxygen and minimizing the amount of methane confined.

"Immediately after completion of the temporary seals all men should leave the mine and stay out at least for a period of 24 to 48 hours, depending on the extent of area sealed. This is a necessary precaution in order to avoid an explosion, should one occur within the enclosed area, as it is problematical at what point the oxygen and methane will pass.

"After sufficient time has elapsed to minimize the possibility of an ignition, the work of building permanent seals should be started and rushed to completion as early as practicable. All material should be available to construct a fireproof stopping such as cement, sand, gravel, brick, hollow tile, or stone; also some pieces of pipe, gate valves and a door frame should be on hand. If it is possible to do so, a water line should be extended to a point inby the seal.

"Great care must be exercised in selecting the location of the permanent seals, having in mind roof conditions and the solidity of the ribs to which the seals should be tied.

"The location should be as close to the temporary seals as possible, for the same reasons as already mentioned. Where two seals are used they should be placed opposite or in the same pillar where it is possible to do so. In the process of construction some pieces of pipe should be provided with valves for the purpose of recording the pressure and taking gas samples. Provision must also be made for a door large enough to pass a stretcher through and for men wearing breathing apparatus. All stoppings should be built strong enough to stand water pressure if it is desired to flood the area.

"After the seals have been completed gas samples should be collected at regular intervals to enable those interested to ascertain just how the fire is behaving. No time limit should be set for the reopening of a fire zone, and more careful and serious consideration should be given to this than to the task of sealing.

"Even after the gas analysis shows the most favorable conditions, the area ought to stand to allow for cooling off; then, if it is desired to enter the enclosed section, an organization consisting of several crews trained in the use of breathing apparatus should be selected. The work should be carefully planned in order that all who take part will thoroughly understand every detail to be carried out.

"All equipment should be carefully examined, and it is also desirable to have a map on some convenient scale of that part of the mine where the fire exists, showing location of seals and proposed placement of air-locks, together with the direction of the air current.

"All work of this character should be done on the assumption that the fire still exists, and preparation should be made accordingly.

"All views to the contrary must be classed as an absolute disregard of safety precautions.

"With the well-organized teams, and all necessary equipment, work should be started in a slow and deliberate manner. Air-locks should be constructed first as a means of preventing the ventilation from entering the enclosed area. Gas samples should be collected at intervals and analysis made immediately; also thermometer readings showing temperature. The exploration must continue in a slow way until the origin of the fire is reached. Here it must be determined beyond a question of doubt whether or not the fire is out; and the next steps to be considered will, of course, depend altogether on conditions as found at the seat of the fire.

"Next in importance is the ventilation of a sealed area that has been closed for a long period, as in such cases the percentage of methane will certainly be very high. The area should be ventilated in sections, moving a certain amount of gas at a time and, as an added precaution, not allowing the air to pass over the origin of the fire. With the restoration of ventilation, rock dusting or watering should follow close behind the territory gained.

"In conclusion let us hope that the mining fraternity will give more careful and serious study to this important subject which has exacted such a large toll of life."

Discussion:

MR. RYAN:

"I want to emphasize the matter of allowing time interval between the completion of temporary seals and the building of permanent seals. I consider that a vital thing in connection with mine fire fighting."

MR. NEWBAKER:

"I would like to ask Mr. Ryan how much time should elapse before beginning the temporary seals."

MR. RYAN:

"That depends on the conditions. Assuming that you know just where you are going to erect the temporary seals, or that the place lends itself, the work should begin promptly. If conditions are favorable it should be done inside of an hour. Just the minute you get it plastered up—get out."

He suggested that for the first 12 to 24 hours it should be left alone. Of course, it should be investigated every hour by two or three of the men, but before any permanent stoppings are thought of the oxygen should be below 13 percent.

MR. MCAULIFFE:

"Don't you think it better to close the intake and return simultaneously, building doors that swing shut? How would you proceed building those stoppings?"

MR. RYAN:

"That is one of the things brought up in my paper. It was discussed at Horning. There were various views expressed. Lot of them said that because the intake was sealed first was what caused the explosion. The fire started at the face, and the first thing they did was to put a temporary seal across No. 16 butt, of three-ply canvas. However, I think Mr. Osler could better tell you how it was done."

MR. OSLER:

"The fire started at No. 16 butt, 40 feet from the last break through the face of No. 16 butt. Canvas stoppings were put across the intake and 7 and 8 return was done in the same way, through the air-lock. We saw no fire showing on No. 16 butt. There was just enough air allowed to circulate to keep it free from smoke, and run a brattice up to within about 40 feet of the other break-through. We saw the fire under the machine truck and at the face of the entry above. The fire looked insignificant, and we thought that within an hour we would have it out. In the meantime we brought up the stopping material—we brought up the water box—and I wish to say that we had no water, the supply being 2 miles away. They used the water box, got up with the brattice, and the fellows tried to put the fire out there. The fire was so small then we tried to move the truck, but we were afraid the current of air would start the fire afresh. We figured the best thing to do until we could get a chance to fight a little better with more water was to put up a temporary curtain right over the mouth of that entry. While bringing the material up the fire kept growing, and at that time it was decided that the best thing was to seal it. A three-ply wet canvas was put up within 20 to 25 minutes of each other. A temporary sealing was put up. We built a single brick wall at about 3.30 o'clock, and intended at that time to go right ahead and build a 9-inch brick wall. I left at 3.30 with the chief engineer and we were going out the bottom shaft when the explosion occurred. We thought there would be a very heavy roof fall, but there was only about 8 inches came down. Whether it came down during the explosion nobody knows. It was coke when we got in, 40 days after. So you see we did not go far towards putting in permanent sealing."

A question was asked if a fire mechanical engine would have enabled them to control the fire.

Mr. Osler answered, and said if they had had an engine at that mine the fire could probably have been put out. At the mines they are now using chemical sulphuric acid and carbonated soda, in 40-gallon tanks.

There were questions as to what effect it would have, as far as CO was concerned, if the oxygen were cut off—whether it would make more CO; whether it would have any effect on the explosion; what effect the gain of CO would have; would reducing the oxygen cause the explosion? These questions were fully covered in the paper which Mr. Ryan had given.

MR. CATHER:

"When you shut both doors together, you keep conditions neutral. When you cut off the oxygen you are making CO. There is no question about that."

MR. RYAN:

"When you shut both doors you are reducing the oxygen. You will not produce much CO until you get your oxygen reduced. Reduce your oxygen with combustion and just the minute you start to reduce it you change your explosive elements. You are getting protection right from the start. When you get down to the point where you are producing CO through lack of oxygen you do not have much hazard—not when you get below 13, between 13 and 15 percent. I would say that when you get to the point where you produce more of CO the oxygen has been reduced."

MR. CATHER:

"Would the production of CO not have this effect by reason of superior gravity?"

MR. RYAN:

"CO and the explosive mixture would start a fire. That is something we ought to know more about. The subject is one that needs some research work, and it must be done without having to start a fire to find out. We have a wonderful lot of data, but we do not want to create a condition to get data. Samples were taken every couple of hours of the atmosphere, and we discovered just about an hour before the second explosion that we had a sample of the return which was running between 3½ and 4 percent methane. With the CO detector it showed 2½ to 3 percent. The flame started to dim in the safety lamp for lack of oxygen."

MR. CATHER:

"What about the stratification? That is a thing we should know about."

MR. RYAN:

"It would be easy to find out. My opinion is that we are laboring under considerable confusion in the respect that diffusion has more influence than stratification. Inside of 24 hours on the roof of the whole area the gas had diffused, and in so far as we could tell when taking samples, we had about the same atmosphere between, CO, CO_2, and oxygen, as we had at the face.

"When malleable iron goes off under pressure, it goes to the roof. If you stop the moving current, it has a tendency to stratify. In a still atmosphere the gases will diffuse so it will not stratify. Again there is considerable difficulty and wrong interpretations as to conditions likely to exist figuring on stratification. It is true that as long as air is creating a current there is stratification. Shutting off the air, diffusion immediately takes place. That question is important. One theory in putting the seals back some distance, say 1,000 feet, is to give you immunity. Malleable iron will gather clear back to the seals."

MR. CATHER:

"One thought I had in mind with the possible limited area is that the heavy gravity, and CO settling to the bottom is necessarily concentrating and gathering methane in the place."

MR. RYAN:

"Yes; that condition exists before it is diffused. You do get a film of CO. CO_2 has very little effect in changing the lower explosive limit.

"A fire is usually inaccessible, even though you have rock dust to throw upon it. We are working on a theory to build a machine to throw dust, to run on small tracks. I believe we could have put the fire out at the vein with something of this sort. We have put out fires starting in the mines with rock dust. We have it in all parts of the mine, and carry it with us in bags."

MR. ENZIAN:

"With reference to the practice of closing your seals simultaneously. We had a very serious explosion, one which generated an excessive amount of gas. It occurred about 3 o'clock in the afternoon, after all the men had left. The origin of the explosion was never determined. Immediately the officials were called, including the fire bosses, and everyone from the general manager down had his say and said it quickly. A definite program was arranged. In six hours the seals had been built and the situation left undisturbed. Substantial rooms were built with doors. At a given signal all watches would synchronize and the doors of both the intake and return closed. As an additional precaution, a hoisting rope was attached to the second door, after everyone was out. The main intake door on the slope was closed with an engine. The slope rope had been fastened to that. We immediately started samples in the upcast. That had also been closely sealed. Through the air-locks samples were taken every two hours. After 14 days we started to reopen it. The analysis seemed to indicate there was no more fire. However, six months after reopening the seals we found hot strata and very hot coal, but no fire."

FIRE PROTECTION UNDERGROUND

WM. Z. PRICE, *Asst. Supt., Buckeye Coal Co.:*

"Mine fires may originate from many causes, and we all agree that a fire underground is a serious and formidable proposition regardless of its extent. Danger is ever present on account of the evolution of noxious (*Continued on page* 522)

UNDERGROUND TRANSPORTATION AND ITS RELATION TO EFFICIENT MINING

Problems Of Underground Transportation As Discussed At Cincinnati Include "Importance Of Good Track For Safe, Efficient And Low Cost Haulage;" "Track Work, Details and Maintenance;" "Selecting A Mine Car Design;" "Dispatching For Long Haulage"

R. L. KINGSLAND, *Superintendent, Power and Mining Department, Consolidation Coal Co.,* served as chairman of the closing session of the Cincinnati meeting, which included discussion of four phases of underground transportation problems.

IMPORTANCE OF GOOD TRACK FOR SAFE, EFFICIENT AND LOW COST HAULAGE

A. A. CULP, *Consulting Engineer, Birmingham, Ala.:*

"I think everyone will agree that 'Good Track' is essential to 'Safe, Efficient and Low Cost Haulage.' However, the economical degree of perfection of the track layouts, materials and

Amos A. Culp

construction, is always open to argument.

"Very often, low track costs are obtained at the expense of other unit mining costs and if more thought and money were expended on the haulage system, the greater efficiency would tend to increase the output of the mine and decrease the other cost items. It is equally true that high track costs are sometimes due to insufficient thought and planning and lack of construction maintenance and material standards.

"No matter how good the condition of the tracks, if the layouts are not planned so as to minimize delays to other operations, the haulage system is not efficient. The location of yard and side tracks and the system of train dispatching must all be carefully planned if delays are to be reduced to a minimum.

"Likewise the layouts must be adapted to suit the amount and type of motive power and other rolling stock. Very often a short ruling grade will limit the tonnage of a train over a long haul. The question arises, will it be economical to reduce the grade so as to allow the same locomotive to pull more cars in the same length of time or a smaller locomotive pull the same number of cars? The type of equipment also governs, in a way, the curvature of a track. The wheel bases and flexibility of trucks, determine the minimum practical radius.

"Other speakers will talk on details of track construction and maintenance, so I will only touch on those subjects as they bear relation to the subject assigned to me. To obtain 'Safe, Efficient, and Low Cost Haulage,' it is vitally necessary that the design of materials and the construction and maintenance methods, be standardized.

"Of course, the type of construction and amount of maintenance must depend on the service a track is to give. It would be foolish to spend the time and money on a temporary track that is spent on a main haulageway. Too often, though, temporary tracks become permanent ones, are unsafe, and require excessive maintenance. The labor cost of rebuilding them is often more than that of building new, first quality track.

"If construction details are properly planned and executed, maintenance forces can be reduced to a minimum and tracks maintained at a high rate of efficiency, but if tracks are improperly constructed and improper materials used, a larger number of maintainers can do only negative patch work. The rolling stock will tear up the track as fast as they can repair it.

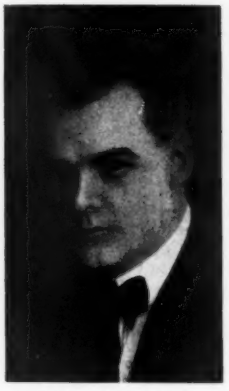
"Standardization of materials will give a more economical and safer haulage because the materials will be designed to suit the transportation and mining conditions, less maintenance will be required and parts will be interchangeable. The track forces themselves will build better and safer track because they will become expert in the proper method of installation.

"A good illustration of the 'Importance of Good Track' is the case of a short line railway in the South, operating very heavy coal and ore trains. Owing to the labor shortage during the war, their trackage got in deplorable condition. Derailments occurred daily and the repair costs on locomotives and cars were out of reason. Operations along the line suffered many costly delays. The track forces spent their time running from place to place patching the track and repairing it after derailments.

"When labor became more plentiful, surveys were made and the railroad practically rebuilt. The curves were eased all possible and the track resurfaced to the newly established gradients. Ditches were cleaned out, new cross ties and ballast were put in and heavier rail laid on some of the sections. As a result, six main line locomotives are now doing the work which formerly required eight. Maintenance of equipment and track costs are greatly reduced. Few delays are experienced by any of the operations. A locomotive which could only pull seventeen 70-ton coal cars can now make the same trip in much less time with 18 cars. This company realizes the value of good track and is now using 100-pound R. E. rail, treated red oak ties and heavy tie plates.

"Some years ago, the Lehigh Valley Railroad started using 136-pound rail, which is a much heavier section than they considered necessary. The rail has been in use a sufficient length of time to show that not only are the track maintenance costs less but the yearly tonnage of rail renewals is less.

"The committee of the American Mining Congress, on Underground Transportation, has done a great deal in the way of standardization of materials and equipment. These standards can and should be adopted by the mining companies as they are adaptable to every condition. Standard for layouts can not very well be drawn up to suit all mines, but if operators plan their layouts properly, select the material standards best suited to their conditions and then see that the tracks are properly constructed, they will reap the benefits of 'Good Track' in the form of 'Safe, Efficient and Low Cost Haulage.' Maximum loads will be hauled in the shortest time with a minimum of power; few delays will occur; transportation costs will be minimized and the operation will be as safe as possible."



R. L. Kingsland

Discussion:

T. B. DRYER, *Assistant General Superintendent, Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.:*

"The advantage of having good tracks on roadbeds is so obvious that it does not seem to lend itself to discussion. There are two instances, however, that I know of where a very material saving was made by the improvement of those facilities under ground.

"I know of two mines in the Birmingham district where this was done. At the first one it was found that after revamping the old equipment it was possible to haul and handle the daily output in about three hours less time than previously required. There was no material gain in tonnage because that was limited, but it had been necessary to hoist three to four hours overtime every day.

"At an old mine covering lots of territory the maximum tonnage obtained was about 1,300 tons. It was thought advisable to increase this tonnage, and a good deal of improvement work was done on haulage equipment. That mine is now producing 2,500 to 2,800 tons per day,

and it sometimes produces as much as 3,000 tons. But, of course, that was not all entirely due to improvement of the tracks, however."

TRACK WORK, DETAILS AND MAINTENANCE

***FRED C. HOHN,** Consulting Engineer, Scranton, Pa.:*

"The efficiency of mine tracks depends upon the class of construction, their maintained condition and adequacy of layout, to facilitate the free and uninterrupted movement of cars in the least time possible, with economical maintenance and construction costs.

"The advantages of good track, constructed and maintained to meet the traffic requirements, are:

"1. Increase in production by keeping the miner supplied with cars to load.

"2. Eliminating derailments and speeding up the trips, which increases the car-miles per start, decreasing car equipment and transportation operating cost.

"3. Reducing preparation costs by delivering the coal promptly at the tipple.

"4. Decreasing maintenance expense of rolling-stock equipment by eliminating unnecessary wear and tear.

"This can be accomplished by the organization of track labor under competent supervision and materials of kind and design proportional to the weight of rolling equipment and intensity of traffic with less cost than under the present methods of track maintenance and construction:

"1. Through the employment of skilled trackmen under direct supervision, accomplishing more work of better workmanship.

"2. Increasing production by keeping the producer on coal.

"3. Standardization of materials of kind and design that will stand up under the traffic.

"4. Eliminating waste of materials by removing dead tracks promptly, proper distribution, and care.

"To determine the organization and materials required to accomplish the above results, a study of the mining program must be made to ascertain the location, origin, and quantity of the loads, class and intensity of traffic, grades and alignment, and life of the facilities.

"This information is obtainable in any mining operation from which a definite reconstruction, standardization, and maintenance work program can be made for the ensuing years and carried out as planned without additional expense, and the cost kept within predetermined appropriations proportional to tons produced.

"Track facilities must be considered, especially at the foot and top of shafts, mouth of slopes and drifts, and tipple yards, that can be economically operated without delays, and of sufficient storage capacity to balance the short delays that occur in the different operations to avoid extending the delay over the entire property, causing a complete shutdown and loss of production.

"Grades are not given serious consideration ordinarily in mine transportation, which is very important if the maximum tonnage is to be hauled with the power equipment. This is especially important on tracks operated by storage-battery locomotives, as a short, heavy grade often consumes more power than the rest of the haulage.

"Transportation is a contributing factor to maximum production, as the miner must have cars to load, and as robbing increases larger mining areas must be opened up with additional trackage, increasing the liability of transportation delays and reduction in production per producer is unavoidable.

"Efforts are being made by some companies to accomplish the above results, through cars and power of the latest types, without giving their tracks the same consideration in determining their transportation needs. As a result the efficiency of this equipment is lost on account of poor track by increasing the liabilities of derailment instead of eliminating them.

"Too often derailments are taken as a matter of fact or a necessary adjunct to car movement.

"I have found track in the mines costing as much to maintain as the best railroad tracks. It sounds ridiculous when you consider the requirements of the one as compared to the other. The reason is that the railroad tracks are scientifically developed and maintained to secure the maximum service life out of the materials and labor employed, while the mine track is only a makeshift with materials unsuitable for the purpose for which they are used, improperly installed and little or no maintenance, with the result that their service life is cut short and labor wasted in continued patching.

"While the importance of good track has been appreciated for a long time, their development has been slow, due to the false impression that their cost is prohibitive, or sheer ignorance of what constitutes a track.

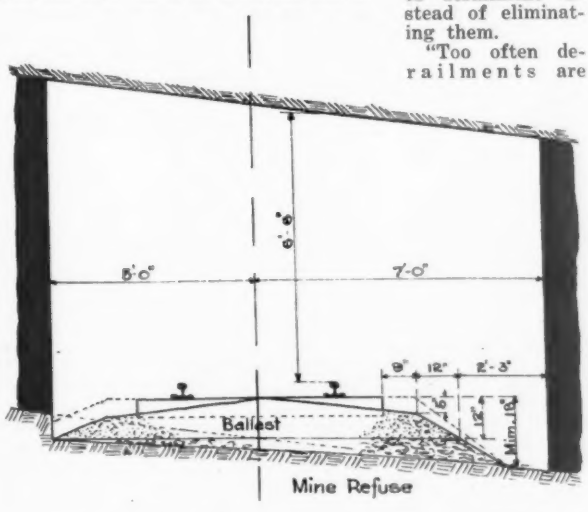
"As a matter of fact, tracks scientifically constructed and maintained cost about 50 percent less than poor track in labor and materials, saying nothing of the saving in operating costs and increased production per producer.

"It is also a mistaken idea that you can develop good track by employing high-class materials only.

"Materials, no matter how well designed or of what quality, will not give you the maximum results unless properly installed and maintained.

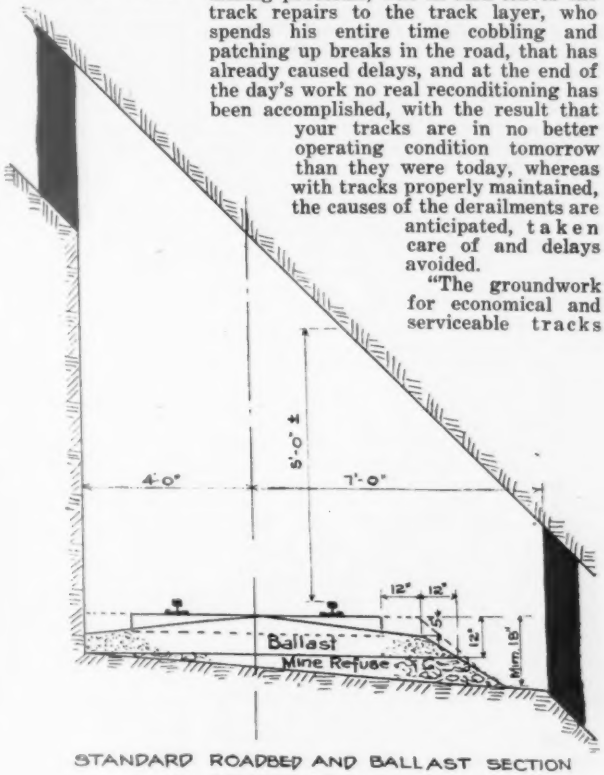
"Mine practices, generally, for doing track work is not done in accordance with any specified program or standards, and is usually left to the sectional foreman, unskilled in this class of work, with his time occupied with production and mining problems, who in turn leaves the track repairs to the track layer, who spends his entire time cobbling and patching up breaks in the road, that has already caused delays, and at the end of the day's work no real reconditioning has been accomplished, with the result that your tracks are in no better operating condition tomorrow than they were today, whereas with tracks properly maintained, the causes of the derailments are anticipated, taken care of and delays avoided.

"The groundwork for economical and serviceable tracks



STANDARD ROADBED AND BALLAST SECTION
FOR MAIN AND SECONDARY HAULAGES
Note Fill in to dotted line on mule haulages

Fig. 1, Mr. Hohn's Paper



STANDARD ROADBED AND BALLAST SECTION
IN PITCHED VEINS
FOR MAIN AND SECONDARY HAULAGES
Note:- Fill in to dotted line on mule haulages

Fig. 2, Mr. Hohn's Paper

lie in their construction. The usage, class of traffic, and service life must be predetermined before the character of construction can be determined.

"It is just as essential to prepare a roadbed with adequate drainage, maximum curvature and grades for mine tracks as it is for railroad tracks, and similar in design as shown by Figures 1 and 2, which I have found to be applicable to most mining conditions.

"Track construction properly is fundamentally the same in all cases, varying only in class of material.

"The selection of the rails are made in accordance with their usage and service life. Mine rails fail from the corrosion of the base or abuse, instead of ball wear, while all light section rails in common use are of the A. S. C. E. type, designed for ball wear and stiffness. In the heavier rails the A. R. A. type B section make an ideal mine rail with a thick, heavy flange to resist corrosion.

"A new section suitable for mine work should be designed with the stiffness, height of fishing space, and width of flange conforming to the A. S. C. E. section with added thickness to flange to combat corrosion.

"Mine rails should be manufactured within prescribed limits of chemical composition and finished with smooth heads, straight in line and surface, without twists, waves, or kinks; sawed square at the ends, and all burrs carefully removed; drilled with circular holes not varying over 1/32-inch in diameter, and length of rails not to vary over ⅜-inch from specified lengths.

"Rail joints can not be passed by lightly, as they bridge the weak part of the rail, and the efficiency of your rail is no more than that of the joint. Angle-bar joints should be used whenever possible, smoothly rolled to conform to specified dimensions and accurately fit the rails for which they are intended.

"Keeping the rail joint tight is too often neglected, and impossible without suitable bolts.

"Bolts with the Harvey-grip thread and recess nuts fitted tight enough so as not to allow over three full turns by hand will take care of your bolt requirements and keep joint maintenance at a minimum with maximum service.

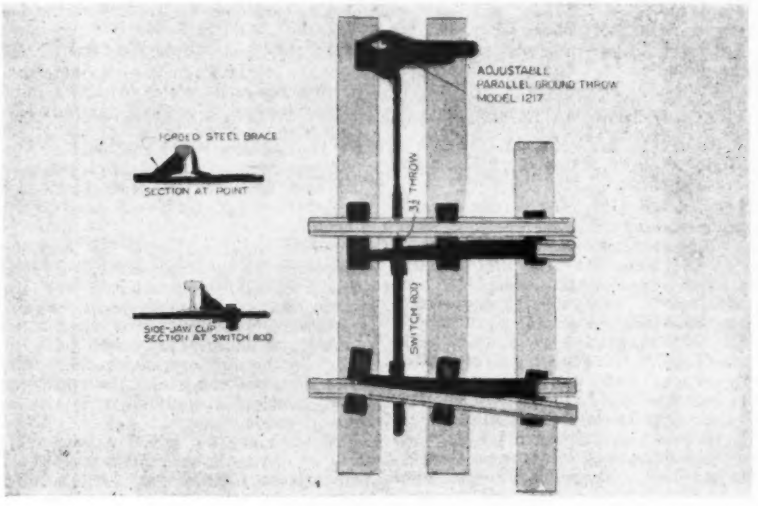
"The track spike, although not given much attention, has its functions to perform the same as the other track materials, and should be well manufactured, with sharp chisel point that when driven in the ties it cuts the fiber of the wood, giving it a firm grip.

"The size of spikes to use is dependent upon the size of rails and ties.

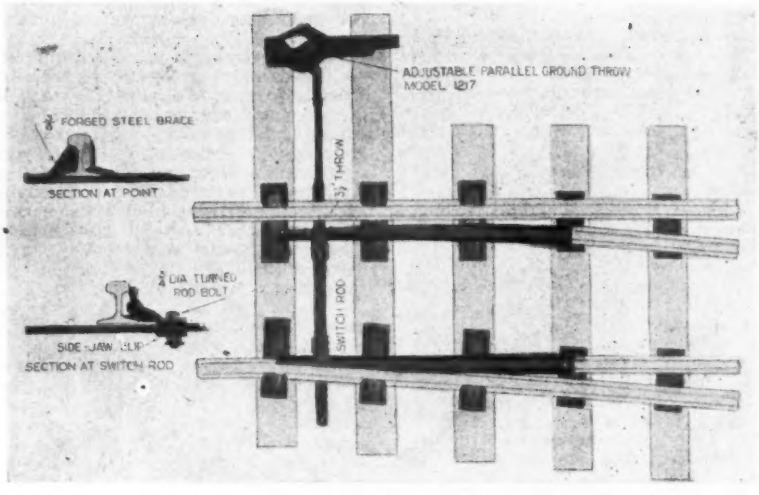
"For 25-pound rail and lighter with 4-inch ties, spikes 7/16-inch by 3-inch are most suitable; for 25-pound and 35-pound rails with 5-inch ties I would recommend a 7/16-inch by 4-inch spike; and for heavier rails and 6-inch ties the ½-inch by 4½-in spike should be used.

"The mine-tie question is becoming more serious each year, due to the scarcity of tie timber; and they are being manufactured from all kinds of woods, so small that they are nothing more than poles with two sides slightly flattened, and have a service life of one to one and one-half years.

"This class of tie, though cheap in initial cost, is very expensive when you consider cost of installation and the service you get out of them, giving you a higher comparative cost than a No. 1 standard railroad tie.



3'-6" SWITCH COMPLETE



5'-0" SWITCH COMPLETE

Fig. 3, Mr. Hohn's Paper

"An economical mine tie must be large enough and manufactured from white, burr, or rock oak, chestnut, black or honey locust, pitch pine, or equal timber that will resist decay and last at least six years.

"Ties of dimensions 6 by 7 inches, surfaced four sides, or pole ties 6 inches in thickness with 5-inch face top and bottom surfaced two sides and long enough to extend 15 inches beyond the gauge line of rails will meet your tie requirement.

"Treated ties are both economical and suitable for mine work.

"Steel ties have their place in the mine tracks, but are not adapted to general use.

"Seasoning and barking mine ties are not given any consideration in mine work, both of which are necessary if the full value of the tie is to be realized.

"The practice of ballasting track with mine refuse in which the ties are blocked up loosely, sometimes covered with boiler ashes to provide easy walking, certainly will not stay in position, and offers little resistance to the load it must carry.

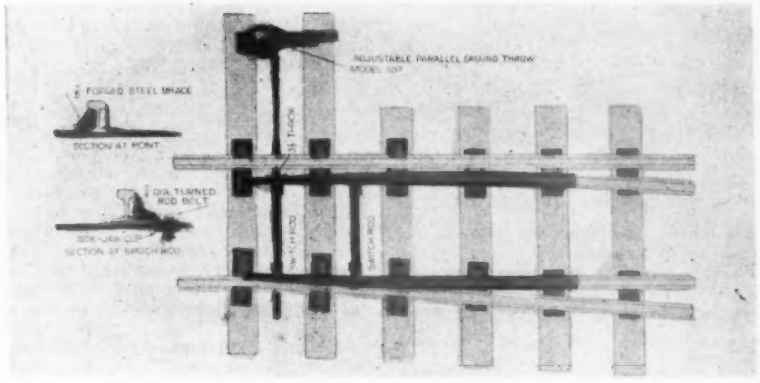
"In properly ballasted track, ties must be bedded to a uniform surface and line, with materials suitable for that purpose, in accordance to a standard ballast section designed to properly support the tie and with sufficient shoulder to keep track in alignment. (See Figures 1 and 2.)

"Crushed stone and hard-coal boiler ashes make excellent ballasting materials.

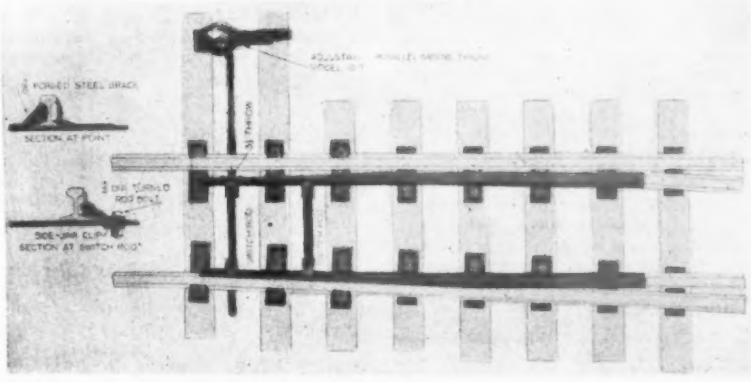
"Turnouts, no matter how well constructed, will offer some impediment to car movement, and with the common practice now employed a large percentage of the transportation detentions can be attributed to derailments over poorly designed, constructed, and maintained turnouts.

"The question of designing turnouts with suitable materials to meet the transportation requirement efficiently has been developed by the Subcommittee on Standardization of Inside Tracks, copies of which are now at your disposal.

"The benefits of well-designed switches, frogs, and turnouts are not only derived in efficient movement of cars but in the wear and tear to your rolling equipment as well.



7'-6" SWITCH COMPLETE



10'-0" SWITCH COMPLETE

Fig. 4, *Mr. Hohn's Paper*

"Some five years ago I standardized in the neighborhood of 5,000 turnouts, with switches designed according to Figures 3 and 4, and cast-steel flange bearing Graham flanged frogs, Figure 5, for less cost than the makeshift types of switches and riveted plate frogs.

"This material is still in operation, and from recent inspection shows that only about 50 percent of their average life is exhausted, while the average service life of the makeshift switches and riveted plate frogs were only one and one-half years.

"New tracks should be laid on a prepared roadbed to line, with ties uniformly spaced and of size as specified for class of track under construction; rails heavier than 25 pounds to be laid with suspended joints, fully plated, bolted, spiked, ballasted and surfaced to a uniform grade, free from sags or humps and in cross level, with ballast uniformly tamped under the ties from end of ties to 10 inches inside the gauge line. The center of the ties should not be tamped to avoid center bound track.

"No elevation is required in outer rails on curves for operating speeds, but should be elevated not over one-half-inch above the inside rail on curves to avoid a reversal in cross level.

"Allowances for expansion on inside tracks is not necessary, and rails should be laid tight.

"All ties should be fully spiked with spikes driven vertically, flush to the rail, and spread as far apart as ties will permit, keeping inside spikes opposite to hold the ties firmly in position. In double track the outside spikes should be spaced ahead of the inside spikes in the direction of traffic.

"All joints should be fully bolted, care being taken not to stretch the bolts beyond their elastic limits, and must be retightened and set up after track has been in service a week or 10 days, or oftener if conditions require it.

"To keep track in a safe operating condition they must be uniformly maintained in accordance with a definite program with skilled trackmen, properly supervised.

"The track forces must be properly tooled in amount and kind to do the work economically in a workmanship like manner.

"Maintenance subdivides itself into the following classes of work:

"Care of roadbed; gauging; tightening bolts; lining and surfacing; renewing ties; relaying rails; ballasting; renewing turnouts; repairing switches; taking up track; distributing materials; care of materials; and bonding.

"The road bed should be kept clean, free from obstructions and refuse, spilled coal picked up, ditches clean and snow and ice removed as soon as the accumulation threatens to interfere with traffic on outside haulages. It is important to keep the rail dry and clean. I have found conditions when sand was used to overcome a condition, created by the excessive use of sand which had been allowed to accumulate and form mud. Mud bound tracks in the mines are inexcusable, and a glaring sign of inefficiency.

"Gauging is important to keep the rails in the proper position with uniform bearing on the ties to avoid spread track and damage to rails. Gauging should be done when general track repairs are made to maintain good line and surface.

"The practice of pulling a rail in position with guage equipped with a hook on one end and ring on the other should never be allowed. The cause of rail spreading is due to flange cut and rail canting out. The spikes should be pulled and ties adzed down to provide a new bearing for the rail. If you cannot hold your track to gauge you should apply tie plates to engage additional bearing surface on the tie.

"Tightening bolts must be given special attention. The joints are the weakest part of the track, and in consideration of the entire subject of track work the maintenance of track joints are most important to preserve the line, surface and protect the ends of the rail from batter and surface bending.

"No efficiency in transportation can be had, irrespective of the rest of the track condition if joints are neglected, for bad joints contribute to derailments, damage to rolling equipment and rails, spillage of coal, bad line and bad surface.

"Bolts will not stay tight when first applied and must be retightened and set up before they will hold.

"Line and surface are very important track requirements and one cannot be maintained without the other. Particular attention must be given to surfacing joints, keeping track in cross level, and free from kinks, waves, sags or humps.

"Before rail is relaid the track must be in good line and surface and ties adzed to give rail a uniform bearing with sufficient roll to cause wheels to run on outer third of head, so as not to damage the new rail.

"To preserve the new rail, all track relaid should be ballasted, ties spaced or renewed, lined and surfaced to establish line and grade, ballast dressed, refuse cleaned up and put out of sight and reclaimed materials sorted, classified for future use, and piled in a convenient point for distribution.

"In renewing ties the old tie should be dug up without disturbing ballast under them or jacking up the track, laid with top of tie up, well tamped, uniformly spaced, ballast dressed off, track gauged, lined, surfaced, bolts tightened, fully spiked and dressed under the rail when necessary.

"In mine work it is often more economical to renew ties out of face, reclaiming all serviceable ties and relaying in tracks having the same service life.

"Ballasting should be done in connection with relaying new rails. All ballast worn out and unfit for future use to be removed, with mud and other refuse to such a depth above or below the ties to permit of the application of the standard depth of ballast to bring the track up to specified grade, well tamped into place, by shovels, bars or air tampers, keeping surface of rail uniform.

"After track has been operated a short time a resurfacing will be necessary and all slight raises tamped with bars or air tampers.

"In connection with relaying rail all turnouts should be renewed and laid with the same weight of material. The

reclaimed material to be sorted and classified and used for repairs, with a general overhauling once a year, renewing in part or in whole materials that are worn out, and make adjustment from time to time to insure the free movement of the cars at all times without interruption.

"When tracks have no future use the materials should be taken up, starting at one end and taking track up as a whole, classify the reclaimed materials and store them at such points as are convenient for use or distribution—sending scrap and old ties to the outside for disposition.

"Materials for new work should be delivered on the job at such times as needed, and maintenance materials to specified points provided for that purpose and convenient to the work, the requirement anticipated and stock replenished at regular intervals, piled neatly and all small materials stored in the tool house, or boxed in the original containers.

"All tracks operated with electric locomotives requiring a return track circuit must be bonded. If the protected bond is used, bonding to be done as track is being laid before joints are applied to avoid taking joint off, damaging the bolts and extra cost.

"Punching rails at the mills is inadvisable for terminal bond. The surface of the hole rusts, besides being irregular, and before bonds can be applied must be reamed out. It costs no more to drill the holes on the ground and insure good contact.

"The organization of labor and material to carry out track work as outlined can be readily determined if a track map is developed showing existing roads, weights of rails, power, amount and flow of cars per start by years and mining forecast by years in cars per start for at least five years in advance or even to the exhaustion of the property.

"Maintenance requirements are determined by periodical inspections.

"With the above information the amount of work to be done is readily determined, from which the material and labor requirement can be calculated and scheduled.

"For the different classes of work I have found the following man hours sufficient if properly supervised, to maintain and construct mine track in first class operating condition economically:

MAINTENANCE PER YEAR

Lining and surfacing, 720 hours per mile of track per year.
Repairing switches, 40 hours each per year.
Renewing cross ties, three-fourth hour each per year.
Renewing switch ties, 40 hours per M. B. M.
Relaying rails, 1,200 hours per mile of track.
Spacing ties and surfacing new rail, 1,000 hours per mile of track.
If reballasted, 2,000 hours per mile is required.
Cleaning ditches, 300 hours per mile of track.
Distributing materials, 100 hours per mile of track.
Renewing turnouts:
No. 2 and 3, 16 hours each.
No. 4, 32 hours each.
No. 6, 40 hours each.
Taking up track, 300 hours per mile of track.

CONSTRUCTION

"It requires 3,000 man-hours to build a mile of new track complete, including ballasting, with additional allowances as follows:

No. 2 and 3 turnouts, 16 hours each.
No. 4 turnouts, 32 hours each.
No. 6 turnouts, 40 hours each.
Distributing materials, 300 hours per track mile.
Cleaning up tracks, 300 hours per track mile.

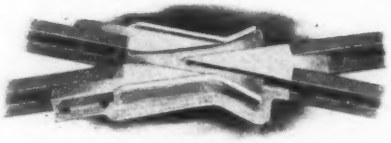


Fig. 5, Mr. Hohn's Paper.—Flange Bearing—Graham Flanged Frog

"For normal maintenance you can determine your maintenance forces by the following equivalent man-hours per mile of track:

Main haulage roads, 1.5 miles per man per 8-hour day.
Secondary haulages equal 1¼ miles of main haulage roads.
Twenty switches on main haulage roads equal 1 mile of track.
Twenty-five switches on counter haulage roads equal 1 mile of track.

"I have only endeavored to give you briefly the fundamental principles of efficient and economical track construction and maintenance, designed proportionately equal to the better classes of rolling equipment now coming into common use that will insure the free and uninterrupted movement of the cars at the least possible cost."

Discussion:

MR. TAYLOR, *Franklin Co. Coal Co.:*

"I believe I heard a statement of average life of a tie as being one and one-half years. Is that correct? I am referring to 5 by 8 ties."

MR. HOHN:

"I was referring to 1½-inch ties in thickness. You ought to get six to seven years out of 5 by 8 ties."

MR. TAYLOR:

"You mention about six years, and I wish to ask you if you are able to give any figures in connection with treating ties, differences in life, and costs."

MR. HOHN:

"I do not believe there are any definite figures on treating ties. In treating ties you should consider your entire equipment. In many mines you have many derailments. Your ties burn out rather than decay. You would make nothing by a treated tie. You have also to consider the economy."

MR. TAYLOR:

"Our conditions give us a lot of dry rot. We don't average over 10 months to a tie."

MR. CULP:

"The A. R. A. sent out questionnaires to the railroads some years ago, and their tie committee and that on wood preservation have shown the life of a treated red-oak tie, properly treated and plated, to be 15 to 20 years. One untreated averages 3.7 years. White oak last almost twice as long."

MR. TAYLOR:

"Are those sawed and pressure treated?"

MR. CULP:

"They are treated with 10 pounds creosote oil. They are sawed. The white-oak ties do not take treatment so well."

MR. JOHNSON:

"It was said that steel ties were not adaptable for general use. There are several large coal companies that have started to use steel ties on the main haulage ways. The Consolidation Coal Co. could give something on that. They have installed steel ties with concrete in the main haulage ways."

MR. HAY:

"We have installed a number of heavy steel ties of 60-pound steel in the main haulage ways, and in addition to that there is standard ties and switches. All of the switches and ties are concreted in. This is practically new. They have not been in for very long, but we have found in some of our mines where we have used wooden ties very extensively that this same steel tie can be used to great advantage for replacement. These ties can be spaced in wherever the crack has been found to spread and caused derailments and the tie can be put in very readily and give good service. We have been going into the steel-tie proposition very extensively on heavy steel."

MR. JOHNSON:

"Would you consider it advisable to concrete all your ties for main haulage?"

MR. HAY:

"I should think so."

MR. JOHNSON:

"I have in mind a copper company in Michigan that installed a roadbed similar to that, and they expect it to last 50 to 75 years."

MR. HAY:

"I should think a steel tie concreted in would make a very good roadway. You have, of course, your equipment to be considered as well. Sometimes I feel that in mine equipment it might be well to have a little vibration to your track, rather than have it too solid. It all depends, however, on the equipment you are using. It might be inadvisable to concrete your tracks too solidly; I am not familiar with this entirely, because our work is new in this line. We have not gone into concreting any more than for switches."

MR. HOHN:

"What class of ties are you using?"

MR. HAY:

"Channel tie spread about 4 by 5-in. face. Not I-beam. We hold our track in line without concrete. We are using rock ballast for surface. On the replacement work it seems to work very satisfactorily. Where we have any grades where it might interfere with the transportation of coal we put in braces. Ordinarily it holds very well."

MR. HOHN:

"My experience with steel ties is that the center will bend."

MR. ENZIAN:

"Mr. Hohn, in your studies have you come to the conclusion as to the weight rail for certain equipment, say for 13 to 35 ton locomotives?"

MR. HOHN:

"There are so many different things to be considered that it is hard to standardize. It would depend upon the type of ballast and drainage conditions. Where you have locomotives up to 15 tons, I would recommend 60-pound rail for all main haulage and 40-pound on cross entries and 60-pound to 80-pound on slopes."

MR. JOHNSON:

"What is the proper width for gauge on curves?"

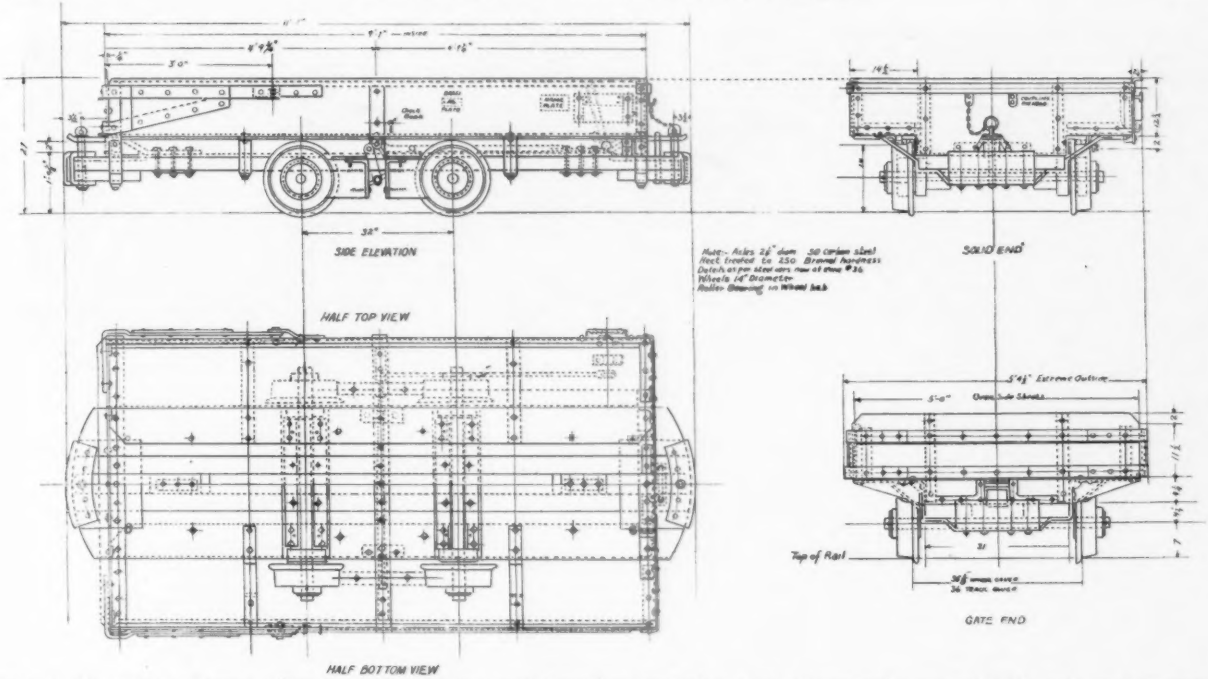


Fig. 2, Mr. Watt's Paper.—Showing side and two end elevations and plan view of composite car with lift gate end construction and flexible roller bearings in wheels

MR. CULP:

"You find the length of the wheel base is short and you have a differential of ¾ to ½-inch, and that will take care of the necessary play. Some companies do have a schedule of widths of gauges, and on some curves if your track would spread you would have no track. It is not necessary to spread the track at curves."

SELECTING A MINE CAR DESIGN

CLARENCE E. WATTS, Mechanical Engineer, Berwind-White Coal Co.:

"The keen competition prevailing in present-day coal production necessitates the most careful and thorough investigation by the officials guiding the destinies of such enterprises into all the different apparatus and equipment used in this industry, in order to obtain and maintain that high plane of efficiency in the operation of its plants necessary to its successful economic existence.

"The constant efforts of numberless minds concentrated over a long period of time upon the development of coal mining apparatus and equipment as a whole is steadily advancing the methods of coal production from a crude and inefficient process to a scientific and highly efficient industry, and still the onward march of such improvements continues with ever new and wonderfully better results.

"There has been a steady improvement in this subject since the earliest days of which there is any authentic history of coal mining (about 1676 in England and Scotland), when baskets carried upon the backs of men served as a medium of transporting the coal from the mines. Later than this date, wheelbarrows replaced the basket method of transportation, down to the year 1842, when tubs having cradle rockets on their bottoms were dragged over plank roads by boys and women constituted the then best known devices of conveyance.

"But with the onward march of industrial activities, soon after this date came the metal rail, upon which small wagons having four wheels and hauled by animal power superseded and greatly improved all previous methods for transporting the constantly increasing volume of coal tonnage in England and also in other countries, this latter equipment proves to have been the forerunner of the present day coal mine car used so extensively in practically all mines in all countries.

"The steady and rapid growth of purchased electrical power has drawn attention to the many sources of savings that can be realized through the use of refined and highly efficient mechanical apparatus and the item of transportation represents one of the major uses for which electrical energy is used in connection with coal production. Consider the great improvement which a mule drawn coal car on metal rails represents in comparison to the ancient method of basket transportation, especially if the distance be great, and of the relative size of the units involved in each system, also the volume of work accomplished by each in a given period of time. Then think of the modern electric haulage system and the volume of work which it can accomplish in a given time as compared to the best mule haulage system known. Electric haulage not only is more efficient than any other known system which has been used, but it permits of transportation over distances impossible of attainment by any of the previously mentioned methods.

"Is there any reason to believe or accept this most superior electric haulage system of the present day as having reached its maximum of perfection, and to neglect the further search and effort to project the science of coal transportation still further up the ladder towards

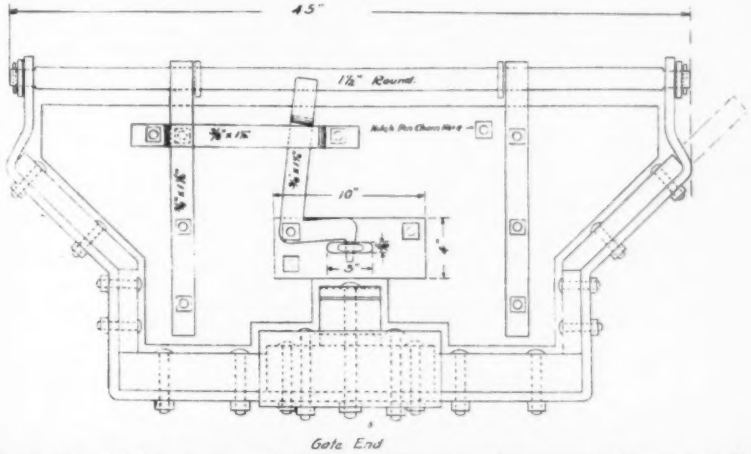


Fig. 1, Mr. Watt's Paper.—Showing swing gate end construction and latching mechanism—wooden car

the goal of more complete and perfect efficiency?

"Owing to the almost infinite number of varying conditions encountered in mining, cars necessarily vary greatly in detail and construction. Therefore in facing the problem of equipping a mine with cars, the following factors are among those requiring consideration:

"(a) Height and quality of coal seam; (b) kind and use of coal; (c) physical characteristics of top and bottom; (d) system and method of payment for mining and loading; (e) system, distance and speed of car distribution, gathering and haulage; (f) dimensions of shaft, width of track gauge, weight of rail; (g) type of dumping equipment at tipple; (h) old cars to be retained in service; (i) standards of shop practice and standard obtainable material for construction and repairs.

"The cleverness in coordinating the above factors in the design of a mine car possessing maximum capacity, convenience of loading and dumping, ability to stay on the track, minimum friction, yardage and maintenance costs will be reflected directly in the economic functioning of the property as a whole, because a car constitutes a tool used and handled by the many different workmen both in and outside the mines to serve an imperative purpose in coal production; for the operator by which the latter aims to show a creditable accounting for capital invested and by which the workman should apply his time and labor to the greatest advantage to himself.

"To date little or nothing in the way of standardization is in evidence, although some corporations have found reasons to adopt a standard car for all its mines, and this may be considered as an argument in favor of a standard car for at least some localities, for instance where a large number of closely located mines are operating in the same seam.

"The three general kinds of cars are those built entirely of wood except for the steel straps and bands about its body; those built entirely of steel; and those built of wood and steel combined. The latter are known as 'composite cars.' Either kind may be designed with plain or roller bearings in wheels or journal boxings, tight or loose axles, swing, lift or tight end gates, and with spring or solid draft gear in light, medium or heavy styles, to be hand or mechanically loaded and fed to self-dumping cages, 'cross-over' or rotary dumping machinery.

"The advantages of *wooden cars* are: Cheap first cost, flexibility of body and ease of repairs by unskilled labor.

"*Steel cars:* Considered superior to wooden cars and (1) same outside dimensions as wooden car; has 10 to 20 percent greater coal capacity, therefore in low seams its height may be reduced several inches less than a wood car of same capacity requiring less man power in loading and dumping a given tonnage; (2) its stiffness prevents drooping ends; (3) it can be built tighter, thus avoiding loss of fine coal in transit; (4) its construction of drop of press forgings make for standard car parts and efficient shop practice, will withstand shocks that would demolish a wooden car. But it costs 40 percent more to build, its steel plates corrode quite rapidly, it requires more highly skilled labor for repairing, and cost of maintenance is greater than wooden cars. The side plates may be bent all in one piece or in sections fastened together by bolts or rivets, the use of bolts facilitating detachment and repairs.

Fig. 3, Mr. Watt's Paper.—Standard composite mine car

Composite cars: The use of steel bottoms in some instances seem objectionable, owing to rapid corrosion, the bottoms always retaining a packed deposit of damp coal siftings in corners, which causes much more rapid deterioration than occurs in the side sheets which are not subject to this packed damp coal deposit. In place of steel, therefore, wood may be used. Such a construction costs less and is somewhat more flexible than the all-steel car, but costs 25 to 30 percent more than the wooden car and is usually less expensive to keep in repair than either the all steel or all wood construction.

Size of Mine Cars

"A car of sufficient size to permit one full day's work for two men in loading would be ideal. The American car greatly exceeds in size those used in England or continental Europe, on account of thickness of coal seams, the European car containing from 800 to 1,400 pounds, while the American car in the anthracite and in many bituminous fields contains as much as 8,000 or 10,000 pounds of coal.

"The thickness of the seam limits the car height, the usual practice ranging between a 52-inch maximum to as low as one-half this amount. The width of entry (dependent upon physical conditions of top and bottom) limits its width, while the allowable wheel base governs its length. Given a low seam with good top, a car of great breadth may be used; but here again comes a difficulty in construction; that is, making the sides strong with great overhang over wheels. Increasing the gauge decreases this difficulty, but at an increased cost of track construction.

"Greater length of car may be obtained by increasing the wheel base beyond the regular 28-inch to 32-inch limits, but here again the difficulty of replacing derailed cars and the large radii necessary to provide smooth movement between tangents is experienced.

"While conditions will be such that there is little choice in the height of a car in low seams, the question may be asked, What is the desirable height of a car in a thick seam?

"In obtaining an answer to this question the muscular energy of men is an item to be considered, as well as the nature of his surroundings, size of tools, etc.

"Dr. F. W. Taylor's experiments indicate that a man can exert 28,000 ft. lbs. of work per hour by constant action at average intensity. Applying this energy to the loading of coal into two cars having height of 52 and 32 inches, respectively, above the rails, and allowing additional 6 inches for clearance, the number of pounds of coal shoveled in an hour would be $\left(\frac{28{,}000}{4.833}\text{ ft.}\right)$ which equals 5,793 pounds into the high car, and $\left(\frac{28{,}000}{3.167}\text{ ft.}\right)$ equals 8,841 pounds into the low car.

"The meaning of this is that with the low car the average man can, with the same muscular effort, load 3,048 more pounds per hour into the low car than he can into the high car. This difference represents a theoretical disadvantage to both mine owner and coal loader in using the higher car. The fact that the figures mentioned may never be reached in actual practice does not, however, alter the advantages of the lower car. Further, there is less breakage of coal and equilibrium is more stable as the center of gravity is lowered.

"The capacity of a given car height is determined only by dimensioning its length and breadth. Assuming the inside length of car body as 10 ft. 6 in., which would appear a desirable maximum owing to the throw of the coal in loading, the wheel base then would necessarily need to be increased over the past prevailing dimensions of 28 to 32 inches to as much as 42-inch maximum. But with such a length of wheel base easy curves and good track and truck design are necessary to procure smooth running and to avoid derailments. The maximum breadth of such a car would, with favorable mine conditions, be around 6 feet 6 inches, and the overhang of sides with a 48-inch track gauge, therefore, would be 16 inches; so that a car having a body box 10 feet 6 inches long by 6 feet 6 inches wide inside and a height of 32 inches above rail would have a content of approximately 100 cubic feet, equivalent to 2½ gross tons coal level full, or 3½ gross tons with average topping.

"The question of whether a small or large car of light, medium, or heavy construction is best adapted to any given set of conditions must be determined by the consideration of the many different items involved in each particular case. In a large, heavily constructed car one has to consider excessive weight, losses due to derailment, and man handling car at face; the necessity of heavy track equipment, high initial cost, etc. On the other hand, large cars usually have superior trucks, and more care is given to

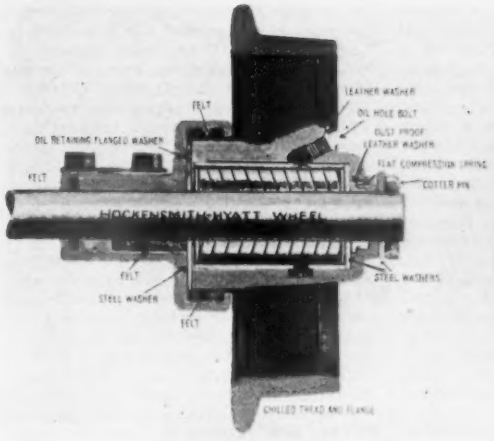


Fig. 4, Mr. Watts' Paper.—Type of roller bearing wheel—flexible roller bearing

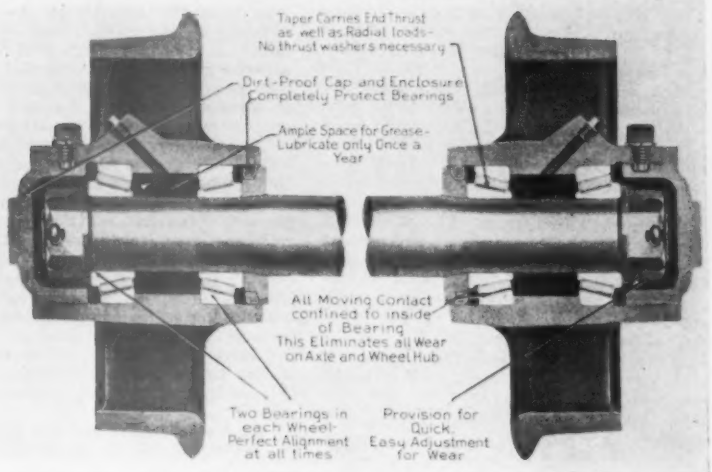

Taper Carries End Thrust as well as Radial loads—No thrust washers necessary
Dirt-Proof Cap and Enclosure Completely Protect Bearings
Ample Space for Grease—Lubricate only Once a Year
All Moving Contact confined to inside of Bearing. This Eliminates all Wear on Axle and Wheel Hub
Two Bearings in each Wheel—Perfect Alignment at all times
Provision for Quick, Easy Adjustment for Wear

Fig. 5, Mr. Watts' Paper.—Type of roller bearing wheel

track maintenance and avoidance of conditions which cause derailments. The present-day practice largely eliminates the necessity of men handling cars at face, this now being accomplished by mechanical or animal power, and this higher initial cost may be more than offset through increased daily tonnage. Unquestionably as far as many of the details connected with the transportation of the car from tipple to working face and return, the advantage lies with the large car, and a survey of the field indicates that present-day practice trends toward car capacities of limits between 3 to 5 gross tons coal capacity.

Weight

It is plainly true that the car having the greatest ratio of weight of coal carried (live load) to the weight of car (dead load) is, other things being equal, the most economical from the standpoint of transportation and manipulation. The natural impression would be that large cars show a more favorable ratio in this respect than small ones, but this is not always borne out in practice, as testified by the following figures, which are an average covering light, medium, and heavy car designs taken from bulletins of the Illinois Coal Mining Investigation:

Kind	Weight of car	Capacity, lbs. coal	Ratio coal to weight car
Light (wood).....	1,400	3,000	2.143 to 1
Medium (steel).....	2,665	4,800	1.80 to 1
Heavy (steel).....	3,700	8,000	2.16 to 1

"The reason why the heavier car shows no advantage is due to steel in place of wood construction, heavier trucks and draft gear.

"*Cars with end gates* are necessary where self-dumping cages and cross-over dumps are used. The lift gate is rapidly superseding the older or swing gate design, but cars having lift-end gates, unless specially reinforced, are inclined to spread open at the gate end, inviting considerable leakage of fine coal and consequent dust on haulage ways; also greater liability to wreckage and consequent breakage of coal.

"*Tight end or solid body cars* eliminate the objectionable features of the lift gate end design, but they require rotary dumps; such arrangements usually result in better economy than can be obtained by gate-end car and cross-over dumping equipment, and seem to be gradually gaining favor in American mining practice.

"*Drop-bottom cars* having chain wind or automatic closing doors on bottom have the advantage of increased capacity and very rapid and cheap dumping mechanism at tipple, but this design is subject to considerable coal leakage, wrecks and high cost of maintenance, especially in rapid haulage systems.

"*Draw bars* having automatic couplers with spring draw heads which permit the rapid handling of trains, absorption of shock, with consequent smooth operation and lessened car repairs, are features well worth incorporating in the design of large capacity cars.

"*Brakes* are of many different styles, but nearly all seem to have too many joints and pins, resulting in much lost motion, lack of effectiveness, and consequent high cost of maintenance; also most of them in use today have a natural tendency to drag slightly on the wheels when in 'off' position. This dragging is a decidedly objectionable feature when the matter of train resistance and what it means to haulage costs is considered, and in many instances cancels a large percentage of the advantages sought through the use of low-friction truck bearings.

"*Trucks.* Aside from the matter of designing a car body to serve any particular set of mining conditions with the highest economy, the truck, whose purpose it is to permit ease and efficiency in transporting immense tonnages over fairly great distances, whose functioning materially affects the cost of coal, whose design embraces axles of different sizes and kinds of steel, wheels of different weights, diameters and shapes, bearings of different designs located either in the wheels, on the axles, or both, mounting of the car body on the truck, and the attachment of brake mechanism, the entire assembled unit represent the item of train resistance, which is a matter heretofore much neglected, offers a most interesting field for profitable research and seems to have escaped to date a satisfactory solution.

"A revolution, or at least a great advancement, in many electric haulage systems in coal mines are the potential possibilities contained in this matter of truck design. It is expected that within the near future research on this subject will bring about further valuable improvements in the science of mine-car design."

Discussion:

W. D. Hockensmith:

"The mine car manufactures have been trying to do just what we want them to do. We should begin at the rail and go up. The question of wheels some of you are familiar with. It is a serious thing how large a wheel should be used on a mine car. It has been checked up in the Bureau of Mines and found that a 14-inch is ideal.

"The friction of a mine car wheel is divided into three different parts—the actual rolling friction, the flange friction and the bearing friction. We used to use large wheels years ago because we had bad roads. We are using small wheels now because we have good roads. Now we can use them because we have small rails.

"Derailments happen in coal mines. They are what bring up the question of brakes on mine cars. In the Pittsburgh district where grades must be considered this is a big question. Depending on a brake, in the dark, that doesn't work, is a serious thing. We have been watching the brake situation and found that any brake part of a car that is below the line of axles is subject to damage and generally out of repair. Therefore a man does not know what he is doing when putting on a brake in the dark. We believe a four-wheel brake is ideal and if you use wood brake construction, you are going to have a good brake.

"Now as to cars. I will confine myself to the composite car. We make the double flare and the mourners' bench type. Those cars were all originally built of wood, limited very much to size. Since we have gone into the composite car, which means the bottom is wood as now constructed in most cars, with the spring draft through the center, with the sides and end of steel plates, we can build this car very much wider. You can go up to 20 inches overhand, if necessary, without affecting the strength of the car. Your car will carry

from 30 percent to 40 percent more coal than the old wooden car of the same dimension. The cost of this is about 15 to 20 percent of the wooden car for the same carrying capacity. They weigh about the same. The steel car has been found after 12 years to be good with the exception of the sides and ends, which are being replaced. We built about 1,000 12 years ago. That is a long life. The cost of repairs of a wooden car is high. The car has to be rebuilt every five years. The steel cars are never rebuilt because at the end of 10 to 12 years they have practically destroyed themselves. The cost of repairs on a steel car in comparison with a wooden car is in favor of the steel car. They do not rust on the inside. The shoots are kept free from moisture by the coal. They rust on the outside, but with oil and an air blast you can keep the cars in good condition on the outside.

"Corners are a bad thing in a car. About 12 years ago a boiler type car was designed, but they could not successfully attach the running gear to the bottom and it had to be abandoned. The bottom buckled. That type of car was a beginning of what has now developed into what might be called the semi-underslung car that is being used today. A car you can now use for hand loading you can also use for mechanical loading. The steel car is ideal for this. I believe any car that is designed today for hand loading, should have at least a 14-inch overtop and it may be able to be loaded with any mechanical device. I figure in a 36-inch high car a man will load 4,000 pounds of coal with the same effort as 3,000 pounds in a 42-inch car. That is an advantage.

"As to size. I feel the future is going to see a 10-ton car. We have an order now for 40 10-ton cars. I feel the time is coming when the longer car will be used. We design a car on a 2½ to 1 basis. We have not learned yet how strong a steel car is and how light they may be made. We are still following the old design. I think the future will see a car carrying 2½ times its own weight. I feel that a composite car with all the corners eliminated, that you can take care of with a maximum capacity and a minimum cost, will probably be the car that will be used in the future, and increased capacity seems to be the cry of the day."

DESPATCHING FOR LONG HAULAGE

J. B. HICKS. *Electrical Engr., Consolidation Coal Co.:*

"Coal mines are usually divided into two general groups, namely, nongaseous, or open light mines; gaseous or closed light mines. Because of the difference in the two classes of mines, it is obvious that there must be a difference in the systems of dispatching.

"I shall first discuss in general a system for dispatching haulage in nongaseous or open light mines.

"The most efficient system of dispatching, known today, is by the use of the telephone. For this reason, I shall discuss this system and recommend its use in non-gaseous or open light mines.

"Dispatching by telephone requires a dispatching office located near the shaft bottom or tipple. In this office is a switch board with a sufficient number of lines to take care of all sidetracks in the mine. There is an independent line from the switchboard to the phone at each of the side tracks, the purpose being to eliminate the possibility of a misunderstanding of orders. Any communication from one section of the mine to the other passes through the main switch board in the dispatcher's office.

"The lines from the dispatcher's office to the different sections of the mine should be laid in lead sheathed and armored cable of a sufficient number of pairs to take care of the mine requirements. These cables may be suspended from the rib or roof by means of any good mechanical method. Personally, I think it is best to bury the cables in the bottom, concrete them in, or pull them through ducts made of tile. In laying the cable, one must provide hand holes on the rib at the different face and butt entries for the phone lines to be tapped off.

"I have insulated a cable of this kind by laying it in a small rectangular, wooden trough, poured hot asphalt over the cable until the trough was full, and then nailed a cover on. This prevented the lead from being eaten away by electrolysis and also gave good mechanical protection.

"As stated before, the cables or wires may be suspended from the rib or roof, but they are not so well protected from falls as if they were buried or concreted in the bottom. If the bottom is inclined to heave, the cable should be placed closely against the rib of the entry as there is less tendency of disturbance from bottom heaving at this point.

"At each phone station, I would have a hole cut in the rib to be used as a phone booth. A door could be placed on this booth so that anyone could talk without disturbance while the trips are passing. A spring could be attached to this door to hold it open when the phone is not being used so that anyone near at hand could hear the bell and answer a call.

"An outline of the dispatching office and phone equipment to the different sections of the mine has been made. We are now ready to define the duties of the dispatcher and motorman in connection with the handling of the trips.

"The dispatcher must first have absolute control of the entire haulage system covering the movements of all locomotives.

"Placing the dispatcher in absolute control of the movements of all locomotives, however, does not in any way relieve the mine foreman of the responsibility of assigning equipment to the sections to which it is best adapted. All orders governing assignment and transfer of equipment to and from sections are issued to the motormen only through the dispatcher who gives them right of way to their destinations. The duties of the dispatcher calls for him to direct the movement of all locomotives to the best advantage. In order to do this, he has a sheet before him giving all locomotive numbers, check numbers of motormen and brakemen, and sections in which they are working. He has the time required for the locomotives to make round trips, number of men at work in each section and number of empties required to take care of all the loaders.

"At the beginning of the shift, each motorman on the gathering locomotives calls the dispatcher, giving the locomotive number, check number of the brakeman and himself and proceeds to his side track as ordered. When these motormen reach their side tracks, they call the dispatcher to report the number of empties there; after placing up the first trip of empties the motorman returns to the side track, calls the dispatcher giving him the number of loaders in the section and number of loads which he has placed on side track. Arriving at the side track each trip, the motorman on the gathering locomotive calls in, giving the number of loaders in the section and reports loads and empties on the side track. On successive trips, he reports any delays waiting for empties, loads or wrecks. Loaders leaving the section before cleaning up are reported to the dispatcher. This enables the dispatcher to send the correct number of empties to the different side tracks, thereby making it possible to distribute the empties to the best advantage.

"At the end of the shift, the motormen on the gathering locomotives call the dispatcher from their side tracks and report loads and empties on side track and receive orders to go to the motor barn. After the locomotive is in its stall, the motorman calls the dispatcher and reports the locomotive number, check numbers of the brakemen and himself. This gives an accurate check on the main-line locomotives then calls motive and time worked by men.

"As a general rule, the gathering locomotives are started to their sections first, as already described. Each motorman on the main-line locomotives then calls the dispatcher, giving locomotive number, check numbers of brakemen and himself. The dispatcher advises him of number of empties to be taken, side tracks at which they are to be placed, and where to get his trip of loads. As soon as he is coupled to the loads the motorman calls in for orders to come to the shaft bottom or tipple. When the loads are set off, the motorman reports to the dispatcher the number of loads hauled, reasons for any delays, and receives orders governing his movement and number of empties to be delivered to the side tracks. This operation is followed throughout the shift until the motorman is ordered to the motor barn. After his locomotive has been placed in its stall, the motorman calls in, giving the locomotive number and check numbers of the brakeman and himself.

"When the number of locomotives coming to the shaft bottom or tipple is so great that delays are encountered in waiting for locomotives to clear, a system of intermediate haulage becomes necessary. This intermediate haulage is dispatched similar to that of the main-line haulage.

"When it becomes necessary to have a number of main-line locomotives traveling over single track, an automatic block signal system should be installed to guard against rear-end collisions. With no block-signal system in effect, under such conditions, it would become necessary, from a safety standpoint, to use a rear brakeman to flag against other locomotives in the event of a wreck in the trip.

"At the end of the shift the dispatcher totals his record sheet, which gives a complete summary of loads and empties handled, delays, section in which they occur and the cause of same. A summary of this sheet is given to the mine foreman, enabling him to analyze the haul-

age record for the shift with the purpose of removing causes for any delays.

"By placing the haulage in charge of a dispatcher, the mine foreman is relieved of a large amount of detail. He can use the phone to keep in close touch with all operations of the mine, and at the same time personally supervise the work in different sections.

"This system of dispatching in non-gaseous or open-light mines insures the most efficient use of all locomotives and mine cars, reduces delays to a minimum, and enables the mine foreman to use his time to better advantage.

"In dispatching long haulage in gaseous or closed-light mines, we are confronted with an entirely different problem. The reason for this is that the most efficient dispatching method, that of using the telephone, can not be used with safety, as there are no phones manufactured today which bear the United States Bureau of Mines approval for use in gaseous or closed-light mines.

"In the gaseous or closed-light mines we use a motor boss instead of a dispatcher. He has full charge of all haulage and must keep all locomotives working to the best advantage and see that mine cars are distributed properly. The motor boss keeps in touch with the gathering locomotives through the motormen on the main-line locomotives, but visits each section as often as possible during the shift. He relieves the mine foreman of the detail of handling the locomotives and trips, but does not in any way relieve him of the responsibility of assigning the equipment to the sections to which it is best adapted.

"The gathering locomotives are first sent to their sections by the motor boss, who gives each motorman a daily report card, on which he records the time of leaving and returning to the motor barn, loads pulled, empties handled, number of loaders, places hauled from, places cleaned up, places partly cleaned up, and delays waiting for loads, empties, or wrecks. At the end of the shift the motorman and brakeman record the time, put their check numbers on this card, sign and turn it in to the motor boss.

"From these cards the motor boss gets the time worked by each motorman and brakeman, a complete record of the haulage for the shift, and the causes of any delays, all of which he summarizes and reports to the mine foreman.

"At each side track in the gathering-locomotive sections there is placed a small blackboard with spaces having the headings: Cuts, part cuts, clean ups, loads, empties, number of loaders, and locomotive number. These are filled in by the motorman after each trip. By looking at this board, the motor boss or the other foreman can tell how the turn is running in the section.

"All motormen on gathering locomotives are instructed and warned that from the beginning to the end of the shift, main-line locomotives have absolute right of way and are not on the lookout for any gathering locomotives.

"Should it become necessary at any time during the shift for any of the gathering locomotives to go to the motor barn or transfer to another section, they can follow the main-line locomotive out. If they miss connections with the main-line locomotive they are permitted to flag in by sending a brakeman ahead to protect against collision. Any transfer of gathering locomotives must be accomplished with a minimum delay to main-line locomotives.

"At the end of the shift the gathering locomotives can safely return to the motor barn, as the right of way for the main-line locomotives has expired.

"After the gathering locomotive is placed in its stall in the motor barn, the motorman fills out his card, turns it in to the motor boss, and his shift is completed.

"At the beginning of the shift and after the gathering locomotives are sent out, the motor boss gives each motorman on the main-line locomotives a card to fill out during the shift. This card shows the number of sections served, empties and loads per trip, number of trips and delays waiting for loads, empties, or wrecks. The motor boss then sends the main-line locomotives to their sections, with instructions as to where to leave the empties and from which side tracks loads are to be picked up. The loads are brought in to the shaft bottom or tipple, set off, and the locomotive run light to the empty track. A blackboard is located near the empty track and has spaces showing number of sections served, loads, empties, the numbers of the locomotives, and time of arrival and departure of same. These are filled in after each trip by the motorman, so that the motor boss and foreman can tell how the different sections are being served, can check the production of these sections, and tell the location of the locomotives. This method is followed throughout the shift.

"At the end of the shift the motorman on the main-line locomotives place their locomotives in the stalls in the motor barn, total and sign their cards, and turn them in to the motor boss. The motor boss summarizes these cards in his report to the mine foreman.

"If a main-line locomotive should have to leave the motor barn immediately after the end of the shift a brakeman must be sent ahead to flag, the same as is required of a gathering locomotive running on the main-line track during the shift.

"To prevent any motorman on a locomotive from turning in a false report of time required to make a trip, a time study must be made of each section and the motor boss furnished with a record of the time required for any trip.

"When the number of locomotives delivering trips to the shaft bottom or tipple becomes so great that delays are encountered in waiting for locomotives to clear, it is necessary to install an intermediate haulage system between gathering locomotive and main-line locomotive side tracks. This intermediate haulage system is handled similar to that of the gathering locomotives.

"When two or more main-line locomotives are operated over a single track it is necessary, from a safety standpoint, to have a rear brakeman to flag against the other locomotives to prevent rear-end collisions in the event of a delay in the forward trip.

"At important junction points it is necessary to station flagman to align switches and give locomotives the right of way in and out of sections.

"This system of dispatching haulage on schedule by a motor boss in gaseous or closed-light mines insures the safety and most efficient use of all locomotives and mine cars, reduces delays to a minimum, and enables the mine foreman to use his time to the best advantage.

"It is obvious that the motor boss dispatching system is not as efficient as the telephone dispatching system. This condition can only be remedied by the development of a telephone which will meet the approval requirements of the United States Bureau of Mines.

"I have now made an outline of a telephone dispatching system for use in non-gaseous or open-light mines and a motor boss dispatching system for use in gaseous or closed-light mines. Both of these systems are in general use today, and with the cooperation of the mine organization have worked safely and efficiently in dispatching for the long haulage."

Discussion:

THOS. G. FEAR, *Gen. Mgr., Inland Collieries Co.:*

"I am going to tell you what we have done with a mine with a tonnage of 3,000 tons a day using two 15-ton locomotives over main haul. Simplicity is the keynote of everything. We use the telephones in the mines, and this mine is a closed-lamp gaseous mine. We have quota charts for all men underground. When the company to which we furnish our coal requires a certain amount, we have a general meeting with mine superintendent, motor bosses, and mine foreman and tell them what we want. Each foreman is allowed two double locomotives and gathering operators, and when the tonnage requirement is increased we have to increase the number of gathering locomotives. We have never used more than two main-line locomotives at one time. The motor bosses direct the locomotive operators into which section to go in the morning. He knows where the loads of emptied cars are. The motor boss does not stay in the bottom. When you are working with the Jacksonville agreement you can not afford this. Every $7.50 man on the pay roll makes a jump in the cost of coal. He goes to the different sections to see where there is trouble. We don't have any guide system. When they come in at night the men report to him how many empty and loaded cars they have hauled. This is done for cost analysis. We keep a careful check on our cost of main-line locomotives and storage locomotives.

"In connection with the motor boss, we check by the block signal system. I expect to get 2,000 a piece with each 15-ton locomotive. We have double tracks at the bottom and single track at all mine entries. This is quickly operated, and the block and signal consists of on the outside looking toward the shaft bottom or working face, one red and one green lamp. When the locomotive enters this throws the red light on, and on the inside a green light is burning, showing the red light is burning outside."

COAL-DUST HAZARDS IN UNDERGROUND DUMPING

IN MINES equipped with underground loading stations, where coal is dumped from mine cars and hoisted by skips or other means, the coal dust from this dumping and loading introduces an explosion hazard. In response to requests for definite information as to the degree of this hazard and means being employed to combat it by the mining companies, engineers of the Bureau of Mines have made a preliminary study of a number of mines having this system. It was found that practice differed very widely with different mines, and that further investigation is needed.

PREVENTING ACCIDENTS

Fire Protection Underground

(*Continued from page* 511)

gases. A slight back draft from the fire will preclude the workers from doing anything unless they have been amply protected with smoke or gas masks.

"It is not my intention, however, to discuss the many factors pertaining to mine fires; they have been elucidated by others in great length on many occasions. But I wish to point out what one modern mine is doing to prevent fires from assuming serious proportions. Do not infer that this arrangement is the last word, but it is the best that we know or can conjure to combat this ever-present danger.

"The first fire-fighting equipment on a large scale at Nemacolin was the tank car. Two of these cars were built several years ago.

"This tank car, as it is commonly called, is a cylindrical tank with bowed ends, 11 feet long and 4 feet in diameter. It rides on two platform trucks, being suspended horizontally between 5-inch H-beams. Its overall length is 18 feet 6 inches; height, 4 feet 6 inches; with truck widths of 4 feet 9 inches; yet it will round a 16-foot radius curve with ease. It holds 700 gallons of water, which fills it slightly over two-thirds full, the remaining space being occupied by compressed air under 100-pound pressure.

"At one end, mounted on the truck, is a reel holding 200 feet of standard 2½-inch fire hose. This reel has a tank connection along its axis and is directly connected to the hose, so in case of fire the operator needs but to open his valve after pulling out the hose and he has a stream of water under a pressure that bears a favorable comparison to that present in most surface fire fighting.

"As the tank will completely discharge the water in from three to five minutes, the second tank is necessary, the first being recharged meanwhile. With two cars we have 400 feet of hose, that will undoubtedly reach most places; certainly until additional lengths could be forwarded from the surface. Government approved portable air compressors are used throughout the mine, and these are used for charging the tanks after the water is run and its connections closed.

"On each car is a set of hose adapters, which will enable the fire hose to be connected to our water lines, which are standard, while hose couplings are of underwriters thread.

"There are always occasions when it may be necessary to get close to the fire, and in these cases a Hayward nozzle is used. This nozzle is capable of throwing four different streams simultaneously, a lateral spray at right angles to the nozzle with a radius of 35 feet; a diagonal lateral spray just ahead of the first named; another diagonal spray at the end; or a direct stream.

"The nozzle has several detachable rings which vary the flow so that 12 different combinations of streams may be obtained. It is kept in a glass box in the lamp house, so that it can be seen and its availablility known to all employes. Its great advantage is apparent in that the three sheets of water will drive smoke ahead of the hoseman, enabling him to reach the scene of the fire with comparative ease.

"In addition, each working face has a 1-inch water line in it and a 2-inch line close behind, so that water for refilling the tanks is always available. This sprinkling system is under a constant head from a tank on the surface and is not less than 100 pounds at any time. Each working face has a sprinkling hose (½-inch) so that in most cases a fire can be extinguished without calling on the tanks. The main sprinkling line is a 6-inch pipe subdividing into fours and twos.

"I might say in passing that the opposite end of the tank car from the reel can be equipped with a horizontal perforated pipe and the roof and ribs sprayed, like the action of the street sprinklers. This practice was in vogue in our mines until rock dusting began. We found that one tankload will satisfactorily sprinkle 2,000 feet of heading.

"There are other methods, however, present at Nemacolin for fire fighting that are applicable when water for any reason is impractical:

"Each electric motor, whether it be trolley, cable reel, or storage battery—and there are 34 in all—is equipped with a carbon tetrachloride extinguisher. In each section of the mine there are several 2½-gallon carbonated solution sulphuric acid extinguishers. This latter equipment has already saved us from several serious fires. Defective blasting caps igniting the explosive and thence the coal, a roof fall on a battery locomotive shorting the cells, and another on a trolley wire shorting on the rail and igniting the loose roof coal lying about, are samples of potential mine fires that these 2½-gallon extinguishers have smothered. We have these distributed in a ratio of one to every 100 tons of production and find them invaluable.

"Lastly, there are the Foamite 40-gallon tanks. These are necessary adjuncts to the tank cars, as we could easily have fires in places where no track is laid, such as air courses, and were we to wait until sufficient hose was rushed in from the surface before acting the blaze might assume tremendous proportions.

"These fire-foam engines are endorsed by the underwriters and need little discussion by me. They are mounted on wooden carriage wheels, and the whole placed on small flatcars built especially for them and for the purpose of taking them by rail as close as possible to the scene of the fire. They can then be pulled off the truck and taken about like any two-wheeled cart.

"On each flatcar, in addition to the Foamite engine, are four 2½-gallon extinguishers like those previously described; a box of sand; and another containing shovels, picks, axes, saws, hatchets, bars, nails, and a sledge hammer. These boxes are kept locked and sealed, but are easily broken open if necessary.

"This, then, represents our equipment, and we feel that it is necessary for any electrically operated mine. There are also some 30-odd automatic reclosing section circuit breakers, together with several hundred sectional line switches that are helps in handling fires, but naturally can not be classed as fire-fighting equipment."

ROCK DUST MATERIAL FOR COAL MINES

IN its Serial No. 2606, issued May, 1924, the Bureau of Mines gave "Tentative specifications for rock dusting to prevent explosions in mines." The Bureau's specifications for material for rock dusting were incorporated in the Recommended Standard Practices of the American Enginering Standards Committee.

Many samples of material have since been examined by laboratories of the Bureau. It has been found that limestone, dolomite and gypsum are suitable materials for the preparation of the pulverized rock dust and all samples tested have either shown no free silica or a very low percentage of free silica. Therefore, rock dust prepared from any of these should be very satisfactory provided all the dust passes a 20-mesh screen and at least 50 percent passes a 200-mesh screen. Sources of limestone and gypsum convenient to coal mines are described in Bulletin 247 issued in April, 1925, by the Bureau of Mines.

With respect to shales, mill tailings, adobe and clays, many of the samples tested were found to contain above 25 percent of free silica and are considered unsuited for rock dusting purposes. Those operators, who may contemplate the use of shale, clay or adobe for rock dusting, should have the material examined in order to determine whether it is suitable.

The material should be sampled so as to be representative of the deposit from which it is taken. If ground material is supplied to the laboratory, a quantity of not less than one pound should be sent; if the underground material is forwarded, at least 5 pounds should be sent. The Bureau makes such examination without charge. The sample should be forwarded to the Pittsburgh Experiment Station, Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa.

RATE OF COMBUSTION OF COAL-DUST PARTICLES

THE Bureau of Mines has recently completed a second series of experiments which has for its object the gathering of data that will be of direct aid in determining the exact nature of the propagation of a dust explosion. In the first series, a method of accurately sizing the fine coal dust for experiment was developed by floating the finer particles away from the coarser by means of gentle air currents. In the present series, data were obtained on the relative inflammability of the different sizes thus obtained. The tests show that in the small scale apparatus used inflammability does not increase indefinitely as the particle size decreases, but approaches a maximum at a definite size and then falls off. Formerly, it had been generally accepted that explosibility of a dust increases with fineness. The data will be applied in further experiments being conducted along this line.

MINE DRAINAGE AND OIL POLLUTION OF STREAMS

Report Of War Department To Congress Embraces Results Of Two-Year Investigation—Report Finds Against Federal Regulation And Suggests State Control—Recommendations Made.

FOLLOWING its two-year investigation of mine drainage and oil pollution of streams, the War Department in a report to Congress, confines its recommendations for remedial legislation to extension of the 1924 anti-oil pollution act to the discharge of oil from any source into or upon coastal navigable waters, the Great Lakes and their harbors and connecting channels.

"I am not prepared to recommend any Federal legislation for the prevention of pollution by acid mine drainage," says Gen. Harry Taylor, Chief of Engineers of the Army, in his report to Congress, through Secretary of War Davis, who concurs.

Referring to coal mine drainage, the report says:

"Acid mine drainage is produced by water percolating through the pyrites in the shale strata above or below the coal seam, or through coal which contains sulphur. In many mines the drainage water flows out by gravity through open ditches, and the volume of drainage from such mines is unknown. In those mines in which pumping is required it has been found that the amount of the drainage water varies from 5 to 20 tons for each ton of coal mined. It is estimated that there are about 7.6 pounds of sulphuric acid in each ton of mine water. In addition, this mine drainage usually has in solution ferrous and ferric sulphates and other mineral salts.

"Washery wastes contain fine coal or culm, mud, sulphur, and other chemicals in solution or suspension. Oxidation which takes place in culm piles results in the formation of sulphuric acid and ferrous sulphate.

"Mine drainage is highly acid and is a source of serious pollution in some sections of the United States. The mining industry has made little effort to prevent these acid mine waters from reaching the streams. A comparatively small number of mines have installed devices by which the acid is neutralized by some alkaline such as lime, limestone, or marl. Most streams in the mining regions are naturally alkaline and this natural alkalinity was formerly sufficient to neutralize the acid a comparatively short distance below the point of entry into the stream. However, with the growth of the mining industry the quantity of acid mine drainage has gradually exceeded the natural neutralizing capacity of many of the streams, with the result that the detrimental effect is felt at much greater distances from the sources of pollution.

"There are numerous abandoned or worked-out-mines in the mining districts from which acid mine drainage continues to flow in considerable quantities for many years after the abandonment of the mines."

Neutralizing Costs

The report estimates that it would cost coal companies in the Pittsburgh district $3,000,000 per year to neutralize their mine waters to reduce the acidity so to make the streams non-injurious to commerce.

Reference is made to a recent report on mine drainage by the Bureau of Mines, which is endorsed by the Army engineers. This report showed that it would cost $10,000,000 to install plants in Pennsylvania to neutralize acid mine waters, with additional sums for annual upkeep of the plants.

Referring to a recent decision of the Pennsylvania Supreme Court, which enjoined 21 coal companies from discharging polluted waters into Indian Creek, the report says the courts can pass on damage suits resulting from acid mine drainage.

Reference is made to deposits of culm from coal mines which cause shoals in the upper Schuylkill and Lehigh Rivers.

In this connection the House has passed a river and harbor bill which authorizes the War Department to investigate and devise methods to remove the coal dust and culm pollution in the Schuylkill River.

The report says the growth and industrial development of a locality may depend upon the use of its streams for economical disposition of its domestic and industrial wastes, and should pollution of streams in such locality be prohibited, the future development of the section might be impaired. "The value of products of fisheries is small as compared to the value of products of all industries which use the waters for other purposes," says the report. "The problem is one of determination of the use of each waterway which will result in the greatest benefit to the community.

Local Control

"Should the Government undertake the control of pollution generally, there might be a tendency by state and local authorities to relax efforts to study the problem and to enforce local laws, with the result that the entire problem would be left to the Government which would be confronted with the necessity of providing a large organization to cope with the many local problems which would arise," says the report.

"Federal assistance and cooperation will produce more beneficial results with less injury to development of cities and industries than will general Federal legislation," says the report.

The report says acids from mine drainage, washery wastes and discharges from steel plants by their chemical action injure steel hulls or other parts of vessels and metal parts of locks, dams or other navigation structures. Serious injury from these sources, however, is restricted to the Pittsburgh area. The injurious effect of acid pollution on commerce and navigation is confined largely to non-tidal streams which carry drainage from large mining and steel districts. Acid wastes from steel plants when added to waters containing acid mine drainage cause sufficient acid concentration to be injurious to iron or steel. This condition exists on streams in the Pittsburgh area.

"Streams in Pennsylvania, Ohio and West Virginia are polluted from acid mine drainage, but outside of the Pittsburgh area the acidity is not sufficient to appreciably affect commerce or navigation," says the report. Damages by acid water to floating equipment and navigation structures amount to between $500,000 and $600,000 a year in the Pittsburgh area.

Because of the activity and progress of states, municipalities and industries in improving conditions, no Federal legislation is recommended so far as the effect of pollution on fisheries is concerned.

It is said existing Federal agencies can assist communities in studying and solving pollution problems. These agencies are the Army Engineering Department, Public Health Service, and Bureaus of Mines and Fisheries.

Streams Affected

Acid mine drainage and acid discharged from plants making metal products are injurious to metal hulls and boilers on boats and to metal parts of navigation structures in the lower Allegheny and Monogahela, and upper Ohio Rivers.

The report states that the following streams are affected by mine pollution and have an injurious effect on fish:

West Branch of the Susquehanna and tributaries above and west of Williamsport.

Pond, Tradewater, Green and Barren Rivers, western Kentucky.

Big Sandy and tributaries, affecting eastern Kentucky and western West Virginia.

Kanawha and tributaries, Little Kanawha, Guyandotte, and tributaries, New River and tributaries, affecting western West Virginia.

Wheeling Creek, Pennsylvania and West Virginia, at Wheeling, West Virginia, with added pollution from steel mills.

Ohio River, Pittsburgh to Portsmouth, Ohio, also pollution from steel mills.

Upper Ohio River, lower Allegheny River, Monongahela and Youghiogheny Rivers and tributaries, Pittsburgh, injurious to metal hulls, boilers, and metal navigation structures.

Muskingum River and tributaries, southeastern Ohio, also from steel mills.

Hocking River, Ohio and tributaries, Athens, Ohio.

Raccoon Creek and tributaries, southeastern Ohio.

Grasse River, Pyrites and Hermon, New York.

Vermilion River, Pontiac and Streator, Illinois, pollution of 3,233,000 gallons per day, including domestic sewage and industrial wastes.

Cuyahoga River, Akron and Cleveland, also from steel mills, the oil endangering shipping in Cleveland Harbor.

Black River, Ohio, Lorain and Elyria, also from steel mills.

Little and Grand Calumet Rivers, and Calumet River and tributaries, Gary, Indiana, and vicinity, also from steel mills causing shoaling and interfering with pleasure boating.

Chicago Drainage Canal, also from steel mills, coke plants, other industrial wastes, and domestic sewage, 11,112,500 gallons per day.

The report says state laws are adequate to control pollution. Mention is made of the Ohio law which forbids pollution from coal mines, while the Washington and West Virginia laws exempt coal mine wastes.

International Oil Conference

An international oil pollution conference was recently held in Washington, confined to oil pollution on the high seas. This conference recommended a treaty to forbid the discharge of oil within 50 or 150 miles of the seacoasts of the countries approving the agreement. The following countries were reresented at the conference: United States, Belgium, British Empire, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Spain and Sweden.

It was agreed that, while there has been some diminution of oil pollution, due both to the action of governments and the voluntary cooperation of the interests concerned, the evil remains serious in some waters and can only be satisfactorily dealt with by international action.

The principal causes of oil pollution are vessels and land installations and terminals. The conference, however, only dealt with pollution caused by vessels. The only vessels viewed as important sources of oil pollution were considered to be seagoing vessels carrying crude, fuel or diesel oil in bulk as cargo or as fuel for boilers or engines.

While harmful oily mixtures cannot be distinguished by hard and fast lines from those practically innocuous, the conference concluded that a mixture containing more than .05 of 1 percent of the above mentioned oils should be regarded as constituting a nuisance. Such mixtures can generally be recognized by the film visible to the naked eye in daylight in clear weather produced on the surface of the sea.

The conference recommended the establishment of a system of areas adjacent to the coasts of maritime nations, within which discharge of oil or oily mixtures constituting a nuisance should be prohibited. Each country would establish the areas off its own coasts, in consultation with neighboring governments if deemed necessary. The conference recommended that, in the case of governments bordering the open sea, such areas should not extend more than 50 nautical miles from the coast, except that, if such extent is in particular instances found insufficient because of peculiar configuration of the coast line or other special conditions (such as prevailing winds, currents and the extent of fishing grounds), such areas may be extended to a width not exceeding 150 nautical miles. Full information as to the extent of all areas will be circulated to all governments concerned by means of a central agency which it is proposed to set up.

The conference recommended that each government require vessels flying its flag, when within any area prescribed by that or other governments, to refrain from discharging oil or oily mixtures constituting a nuisance.

Already a number of vessels have been equipped with apparatus for the separating of oil from oily mixtures, and it is contemplated that the number of such vessels will increase. In order that the installation of suitable apparatus will not be hindered, the conference recommended that no penalty or disability in the matter of tonnage measurement or payment of dues be incurred by vessels fitting such apparatus, and that dues based on tonnage should not be charged in respect of space rendered unavailable for cargo by the installation of such apparatus.

TIMBER GROWING AIDED BY DRAINAGE

DRAINAGE as a means of timber growing is a new idea in this country, but promising tests by the Lake States Forest Experiment Station indicate that it can be a very successful means. The Forest Service, United States Department of Agriculture, estimates that the rate of tree growth on the 9,000,000 acres of swamp forest in the Lake States may be doubled or trebled by partial drainage.

White cedar, the standard wood for telephone poles and fence posts in many parts of the East and Middle West, spruce and balsam, much-sought-after pulp woods, and eastern tamarack or larch, one of the fastest growing conifers of this region, are the trees that would be most benefited by swamp drainage. Undrained, the swamps offer only a loose, acid soil of peat varying in depth from a few inches to 6 feet or more and swamp forests are typically unthrifty and slow of growth. The few investigations made thus far indicate that partial drainage greatly increases tree growth and the number of seedlings that come up in bare spots. Larch and black spruce were found to increase 5 to 9 times in the rate of height growth after drainage, and 12 to 23 times in volume.

The experiment station will conduct its investigations in cooperation with other state and Federal agencies throughout the coming field season, with additional observations for several years thereafter until the full effect of partial drainage may be clearly estimated.

ALASKAN RAILROAD OPERATES ON BETTER BASIS

A reduction of $394,692 in the deficit of The Alaska Railroad was effected during the first nine months of the current fiscal year, according to a statement by the Interior Department.

The report shows that the deficit for this period in the fiscal year of 1926 was $611,608 as compared with $1,006,300 for the same period of 1925. An increase in the operating earnings of the railroad amounting to $107,901 occurred during the first nine months of the year while the operating expenses were reduced by $286,791.

Reduction in the operating costs of The Alaska Railroad was accomplished chiefly through a decrease in the number of employes. The report shows that an average of 122 less employes per month were employed during the first 9 months of fiscal year of 1926 as compared with the same period in the previous year. An average saving of approximately $21,796 per month in pay roll expenditures resulted.

LEGISLATIVE REVIEW

Congress Session Nearing End—A Number Of Mining Bills Are Being Passed—Silver Purchase, Leasing And Other Measures Have Received Approval—Coal Legislation Is Postponed Until December Session

LEAVING in its wake a stream of important legislative enactments, the present session of Congress is rapidly drawing to a close. There is a feverish rush to dispose of pending legislation and adjourn. Thwarted in their earlier purpose to wind up proceedings in May, Congressional leaders are planning an immediate ending of the session. As this is being written Congress expects to adjourn before June 30, although some members are not so sure of this date and are cancelling engagements previously made for Fourth of July orations in their home districts. Farm legislation and river and harbor improvements have been the stumbling blocks in the path of adjournment. Western and Southern members clamored for legislation to stabilize prices and market the surplus crops of agricultural products through Government agencies, but they were opposed by representatives from the industrial centers, on the ground that it would lead to increased living costs and Government expense. After struggling with the question for three weeks the House rejected all farm aid bills and the battle was renewed in the Senate with no different result. The river and harbor bill was assailed as a "pork barrel" measure, but its House advocates insisted on Congress remaining in session until the Senate disposed of the bill which was favored on the ground that it would reduce transportation costs.

Opposition of the coal industry to Government regulation as embodied in pending bills caused leaders to shelve this question until the December session. The House Committee on Interstate Commerce, after showing a disposition to act on some legislation following the six weeks hearings, waited a month before finally deciding to defer action until next winter. In the Senate frequent efforts of Senator Copeland, of New York, to secure debate and action on his coal bill met signal rebuffs. No one would grant consent to permit the coal bill to be even debated and a motion to take up the bill was defeated by the Senate, which refused to take a record vote on the subject.

Coal legislation promises to lead to attempts to apply Federal regulation to other industries, if it is forced to vote. Members in the House and Senate have given notice that they will propose amendments to the measure so as to provide for regulation of gold, copper, silver, oil and other mining, and to practically all commodities. They say that if coal is to be regulated, all industries should be subjected to Federal supervision. Proposals of this kind will naturally weaken support for coal legislation.

Other mining legislation is receiving favorable action by Congress. While it laid aside the bill granting war mineral claims on account of purchase or lease of property and interest on borrowed capital, because of an unfavorable report from the Secretary of the Interior, the House Committee on Mines and Mining may amend the bill to meet the Secretary's views. He wants it confined to these classes of claims, saying the bill as formerly drawn would reopen all claims and allow new claims not h retofore considered. This bill will be pressed for action at the next session.

Western Senators achieved a signal victory when they secured passage in the face of Treasury opposition of the bill for the purchase of fourteen million ounces of silver at $1 per ounce.

A number of leasing bills have been passed by the House or Senate. They include measures for the lease of gilsonite; for the lease of gold, silver, copper and other metalliferous and non-metalliferous minerals on unallotted Indian lands; and for oil and gas leases on such lands in executive order Indian reservations.

A law was passed which authorizes 20-year leases for gold, silver, and quicksilver on lands conveyed by decisions of courts of private land claims which did not allow mineral rights.

To check the unlawful mining of coal on public lands, the Senate Public Lands Committee reported a bill already passed by the House to define and punish trespassers on such lands.

Investigations by the Bureau of Mines looking to the preparation of peat for domestic fuel are proposed in a bill recently introduced.

The Senate passed a resolution directing an investigation of the causes of increased oil prices by the Federal Trade Commission. The Judiciary Committee of the House ignored a request for an investigation of mergers of oil companies, based on reports of the Department of Justice that they did not violate the law.

Congress passed and the President approved the new railroad dispute mediation act, which abolishes the Railroad Labor Board at Chicago and substitutes a Board of Mediation at Washington which will step in when regional voluntary mediation boards of the railroads and their workers fail to adjust disputes.

Senator Pittman, of Nevada, introduced a bill to apply the mine depletion principle to railroads whose main revenue is from mining products and other natural resources. Repeal of the 5½ percent return guaranty to railroads in order to reduce freight rates has been proposed by Senator Mayfield, of Texas.

The proposed lease of the Muscle Shoals project has been put off to the December session. That session will also be asked to further revise the tax rates, including a reduction of the corporation tax to 10 percent.

War Minerals

S. 3641. Laid on the table by the House Committee on Mines and Mining. This bill proposes to pay war mineral claims on account of losses in connection with the purchase or lease of property, and interest on borrowed capital. The bill has been passed by the Senate but was laid aside by the House Committee on an unfavorable report from the Interior Department, which said it would reopen all cases previously decided and permit claims not heretofore authorized.

Silver Purchase

S. 756. Passed by the Senate. This bill directs the Treasury to purchase fourteen million ounces of silver at $1 per ounce to complete purchases under the Pittman act.

Gilsonite Leases

H. R. 5385. Passed by the House. This bill authorizes two-year prospecting permits on 640 acres for asphalt, gilsonite and elaterite, and 20-year leases on 320 acres if these substances are found, at a royalty of one-eighth of the amount or value at the mine and an advance rental of 50 cents per acre per year.

Mineral Leases

H. R. 12393. Introduced by Mr. Arentz (Rep., Nev.). Passed by the House. This bill authorizes leases for gold, silver, copper and other metalliferous and non-metalliferous minerals on unallotted Indian lands.

S. 4347. Introduced by Mr. Oddie (Rep., Nev.). Reported by the Indian

Committee. This is similar to the foregoing.

S. 4261. Enacted into law. This law authorizes the Interior Department to issue 20-year leases for gold, silver, and quicksilver on lands granted by courts of private land claims which did not convey mineral rights to the grantee. The lessee is to pay the Government from 5 to 12½ percent of the value of products at the mine as produced.

ALASKAN ENTRIES

H. R. 6572. Reported by the Committee on Mines and Mining. This bill would permit a person to make two placer mining locations in each of the recording districts of Alaska.

H. R. 9037. Enacted into law. This law validates certain land entries, including the mineral entry of John H. Haggett in the Portland, Oreg., district.

MINE RESCUE

S. 4455. Introduced by Mr. Sackett (Rep., Ky.). Referred to the Committee on Mines and Mining. This bill proposes to establish a mine rescue station at Madisonville, Ky.

PEAT INVESTIGATION

H. R. 12800. Introduced by Mr. Knutson (Rep., Minn.). Referred to the Committee on Mines and Mining. This bill appropriates $8,000 for investigations by the Bureau of Mines of a process for mechanical de-hydration of peat and the manufacture of carbonized peat briquettes for fuel for domestic use.

H. R. 7371. Reported by the Senate Public Lands Committee. This bill defines and punishes unlawful trespass on Government coal lands.

H. R. 8185. Enacted into law. This law authorizes 10-year mineral leases by the Interior Department on allotted lands of the Crow Indians in Montana. In 50 years the lands will go to the ownership of the Indians.

H. R. 8313. Enacted into law. This law authorizes mining leases on lands allotted to living children of the Crow Indians in Montana.

S. 4055. Enacted into law. This law authorizes patents to lands in New Mexico which have been held for 20 years under color of title.

S. J. Res. 46. Enacted into law. This law provides that mineral and other receipts from school land grants in New Mexico shall be equally divided among the educational institutions of the state.

S. Res. 240. Passed by the Senate. This resolution called on the War and State Departments for information regarding alleged control by England over public lands and natural resources in Panama. The War Department reported that it had no information on the subject.

H. R. 9558. Enacted into law. This law authorizes leases by the Interior Department for minerals on the northern Cheyenne Indian Reservation in Montana. In 50 years the minerals will become the property of the Indians.

H. R. 8306. Enacted into law. This law provides for the coinage of six million 50 cent silver pieces in memory of those who went over the Oregon Trail.

H. J. Res. 230. Enacted into law. This law authorizes the Philadelphia mint to demonstrate the process of minting coins on a stamping press at the South Jersey exposition at Camden in July, August and September.

OIL INQUIRY

S. Res. 31. Passed by the Senate. This resolution directs the Federal Trade Commission to conduct an investigation as to the causes for increased oil and gasoline prices, reporting at the next session.

S. 4152. Passed by the Senate and House. This bill authorizes oil and gas mining leases on unallotted lands in executive order Indian reservations.

S. J. Res. 96. Enacted into law. This law authorizes the Interior Department to allow a 90-day preference right to lease 320 acres of land in the Red River oil region in Oklahoma by those whose placer mining locations were held invalid by court decision.

H. R. 10980. Passed by the House. This bill authorizes oil and gas mining leases in Carbon County, Wyo., to M. D. Woolery, D. S. Wageley, D. M. Kerr, A. J. Denny, M. G. Duncan and M. L. Lundy to replace their placer mining claims. The leases would be for 20 years and the Government would receive a production royalty of 12½ percent.

H. R. 252. Enacted into law. This law authorizes the Government to accept title to land for a postoffice at Donora, Pa., with a reservation by the owner of the land of the underlying natural oil and gas.

OIL MERGER

H. Res. 277. Introduced by Mr. Connally (Dem., Tex.). Adversely reported by the Committee on Judiciary. This resolution called on the Department of Justice for information upon which it based its approval of the mergers of the General Petroleum Corporation with the Standard Oil Co., of New York, and the Associated Oil Co., with the Tidewater Oil Co. The department reported to the committee that these mergers did not violate the law.

H. R. 12773. Introduced by Mr. Appleby (Rep., N. J.). Referred to the Committee on Naval Affairs. This bill is designed to provide for the better conservation and the more economical transportation of helium gas, by authorizing the purchase of 14 gas cells costing $275,000, and two helium tank cars for transportation of helium, costing $200,000.

H. R. 12263. Introduced by Mr. Rathbone (Rep., Ill.). Referred to the Committee on Labor. This bill proposes to

IMPORTANT BILLS REVIEWED IN THIS ISSUE

Mining

S. 3641—Oddie (Rep., Nev.). War Mineral Relief.
S. 756—Pittman (Dem., Nev.). Silver Purchase.
H. R. 5385—Colton (Rep., Utah). Gilsonite Leases.
H. R. 12393—Arentz (Rep., Nev.). Mineral Leases.
S. 4261—Jones (Dem., New Mex.). Gold and Silver Leases.
H. R. 6572—Sutherland (Rep., Alaska). Mining Locations.
S. 4455—Sackett (Rep., Ky.). Mine Rescue Station.
H. R. 12800—Knutson (Rep., Minn.). Peat Investigation.
H. R. 8306—Enacted into Law. Silver Coinage.

Oil

S. Res. 31—Trammell (Dem., Fla.). Price Inquiry.
S. 4152—Passed by Congress. Oil and Gas Leases.
S. J. Res. 96—Enacted into Law. Red River Leases.
H. Res. 277—Adversely reported. Oil Merger Inquiry.

Transportation

H. R. 9463—Enacted into Law. Railroad Labor Mediation.
S. 4390—Pittman (Dem., Nev.). Depletion for Railroads.
H. R. 11616—Gooding (Rep., Idaho). Long and Short Haul Rates.
H. R. 7893—Mayfield (Dem., Tex.). Railroad Rates.

Industrial

H. R. 11616—Passed by House. Stream Pollution Inquiry.
S. 2516—Passed by Senate. Pennsylvania Fire Station.
H. R. 7893—Robinson (Dem., Ark.). Tariff Inquiry.
H. R. 12265—Sabath (Dem., Ill.). Immigration Allowance.
S. 4424—Borah (Rep., Idaho). Immigration Restriction.

establish a division of safety in the Department of Labor.

RAILROAD LABOR

H. R. 9463. Enacted into law. This law provides for a new system of settlement of railroad labor disputes, through agencies established by the railroads and railroad employes, and a Federal board of mediation to which disputes would be carried in case the voluntary boards of mediation set up by the railroad systems are unable to reach agreements. This law replaces the Railroad Labor Board which has been in operation for the last six years. The new Federal board consists of five members as contrasted with the nine members of the Railroad Labor Board. The President has appointed four of the members of the new board, as follows: Former Representative Winslow, of Massachusetts, who was chairman of the House Committee on Interstate Commerce; former Governor Morrow, of Kentucky, and G. W. W. Hanger, of the District of Columbia, who were members of the Railroad Labor Board, and Hywel Davies of the Conciliation Service of the Department of Labor.

DEPLETION PRINCIPLE

S. 4390. Introduced by Mr. Pittman (Dem., Nev.). Referred to the Committee on Interstate Commerce. This bill applies the mine depletion principle to railroads serving mine districts, and exempts them from the law requiring payment to the Government of excess earnings.

H. R. 11616. Amendment to by Mr. Gooding (Rep., Idaho). This amendment forbids railroads from charging more for a short haul than for a long haul.

H. R. 7893. Amendment to by Mr. Mayfield (Dem., Tex.). This amendment proposes to repeal section 15-a of the transportation act which permits rates to be fixed on a basis to assure a return by railroads of 5½ percent.

MUSCLE SHOALS

S. Res. 236. Passed by the Senate. This resolution calls on the Muscle Shoals Commission to report stock ownership in the Muscle Shoals Fertilizer and Power Distributing Companies, and as to an agreement or contract which may exist between the American Cyanamid Co., and the Union Carbide Co.

S. Res. 241. Introduced by Mr. Ashurst (Dem., Ariz.). Referred to the Committee on Irrigation relating to the development of the Colorado River.

STREAM POLLUTION

H. R. 11616. Passed by the House. This bill authorizes river and harbor improvements in various parts of the country, and the purchase by the Government for $11,500,000 of the Cape Cod Canal. It authorizes the survey of the Schuylkill River in Pennsylvania with a view of devising methods to remove pollution caused by the settling of coal dust or culm. It authorizes a survey of Portage and adjacent bays in Alaska to provide an accessible harbor to the Cold Bay oil fields. An appropriation of $500,000 is provided for a survey of power possibilities on various streams.

H. R. 12594. Introduced by Mr. Berger (Soc., Wis.). Referred to the Committee on Civil Service. This bill proposes to establish a minimum wage of $1,800 for civilian employes of the Government.

S. 3170. Passed by the Senate. This bill provides for compensation for disability or death of persons engaged in maritime employment, to be administered by the U. S. Employes Compensation Commission.

NATIONAL FORESTS

S. 565. Enacted into law. This law forbids the creation of new or the addition to existing national forests in New Mexico and Arizona except by act of Congress.

S. 2516. Passed by the Senate and reported by the House Committee on Agriculture. This bill proposes to establish a forest experiment station in Pennsylvania and neighboring States.

S. 3405. Passed by the Senate and reported by the House Committee on Agriculture. This bill proposes to establish a forest experiment station in the Ohio and Mississippi valleys.

TARIFF INQUIRY

H. R. 7893. Amendment to introduced by Mr. Robinson (Dem., Ark.). It provides for investigation by the Tariff Commission of duties on steel ingots, sheets of iron or steel, tubular products, tinware, aluminum articles, electrical machinery, limestone, and magnesite, with a view of reducing duties to a moderate or competitive basis.

H. R. 12412. Introduced by Mr. Morin (Rep., Pa.). Referred to the Committee on Patents. This bill proposes to authorize the licensing of patents owned by the Government, through a commission consisting of the Secretaries of War, Navy and Commerce.

S. 4360. Introduced by Mr. Wadsworth (Rep., N. Y.). Referred to the Committee on Patents. This is similar to the foregoing.

H. R. 9690. Passed by the House and Senate. This bill authorizes a five-year naval airplane construction program, including an experimental metal-clad airship costing $300,000.

H. R. 10312. Enacted into law. This law authorizes the disposition of naval plants no longer required, including the coal depot at Frenchman's Bay, Me.

H. R. 5866. Reported by the Judiciary Committee. This bill authorizes the Lehigh Coal and Navigation Co., to sue the Government in the eastern district of Pennsylvania court for damages to one of its vessels by a Government vessel in the Schuylkill River in March, 1920.

IMMIGRATION BILLS

H. R. 12265. Introduced by Mr. Sabath (Dem., Ill.). Referred to the Committee on Immigration. This bill provides that skilled labor may be admitted into the United States if unemployed labor cannot be found in this country, upon determination by the Secretary of Labor on application of interested parties.

H. R. 12520. Introduced by Mr. Sabath (Dem., Ill.). Referred to the Committee on Immigration. This is similar to the foregoing.

H. R. 12567. Introduced by Mr. Sabath (Dem., Ill.). Referred to the Committee on Immigration. This is similar to the foregoing.

H. J. Res. 250. Introduced by Mr. Douglass (Dem., Mass.) Referred to the Committee on Immigration. This resolution proposes to repeal the national origin provision of the Immigration restriction law.

S. 4424. Introduced by Mr. Borah (Rep., Idaho). Referred to the Committee on Immigration. This bill applies to the immigration restriction law to immigrants from North, Central and South America.

HOUSE PASSES POTASH BILL

Provides for $100,000 *Annual Appropriation for Five-Year Investigations and Tests of Potash Deposits*

CONGRESS is placing the finishing touches on the potash research bill. Its early enactment and approval by the President is confidently expected. Without debate or opposition, the House of Representatives on June 21 unanimously approved the bill, which had been previously passed by the Senate, providing for an annual appropriation of $100,000 for each of the next five years for investigations of deposits and laboratory tests of potash under the supervision of the Secretaries of the Interior and Commerce. This work will be carried on jointly by the Geological Survey and Bureau of Mines, beginning July 1 and continuing until June 30, 1931. The bill had originally passed the Senate with an appropriation of $550,000 for each of the next five years, but by agreement of Senators and Representatives having the legislation in charge, and representatives of the Interior and Commerce Departments and the Budget Bureau, the appropriation was reduced to $100,00 per year in order to harmonize with the economy program of the administration. This action was agreeable to representatives of the mining industry who favored the legislation, with the result that practically no opposition developed to the proposed investi- (*Continued on page* 539)

SCHOOL LAND GRANT LEGISLATION POSTPONED

Secretary Work And Western Congressmen Agree That Further Investigation Of Public Land Questions Should Be Made Before Undertaking Any Change In National Policy—Secretary Sees Danger To Mining And Reclamation

FINAL reports by the Interior Department on proposed legislation for the outright transfer of school lands including the minerals in them to the States have been deferred until the next session of Congress.

Through an agreement reached between Congressmen representing Western States and Secretary Work, definite action was postponed in order to permit officials of the Interior Department to make a complete analysis of the public land questions involved in the issue.

The legislation proposes a reversal of the Federal public land policy in force over a period of 50 years, the law as now stands providing that no grants of school sections containing known minerals shall be transferred to the States, but shall be retained by the National Government.

As a result of conferences with Western Senators and Representatives Secretary Work of the Interior Department, addressed a joint letter to Senator Stanfield, chairman of the Senate Public Land Committee, and Representative Sinnott, chairman of the House Public Land Committee, reviewing the public land history of the country, in which it was pointed out that it has been the national policy of the United States for some 50 years to retain the title in the Government of all minerals found in school grants to the States. A statement was also included showing that 49,278,285 acres of public lands comprising school sections have up to this time been given to the States by the United States.

The letter reviews 14 separate bills introduced into Congress at its present session dealing with the question of changing the present policy of the Government covering school grants to the States, a number of which, the Secretary points out, would result in crippling both mining and reclamation in the West. In concluding the Secretary urges that no legislation effecting a change of policy so fundamental and involving resources of the Government as well as a public trust be enacted without mature consideration. His letter in part follows:

"The questions at issue, dealing as they do with the public domain and its mineral resources, the property of the Nation and the people of all the States, demand a solution free from any narrow sectional or selfish bias. The origin of the title which the Government holds, even more than the tremendous value, actual and potential, of the public lands, requires that any change from long established policies with respect to them should be thoughtfully and maturely worked out in harmony with the fact that we are dealing, not with a local issue, but with an asset of the Government in which every citizen has an interest.

"I need not remind you that our public land system had its foundation in the gift by the original 13 States, notably Virginia, of their own public lands; a donation untrammeled by any condition and free from reservation in favor of their public schools or any other matter of local concern. The Louisiana, Florida, Gadsden, and Alaska Purchases, were made by the Nation and the money expended belonged to the people of all the States. The land acquired from Mexico was an act of the whole people. The explorers who laid the foundation of our claim to the Oregon country were officers of the United States and we owe a debt to the pioneers of the Western country.

"It has not been shown, nor, indeed, seriously asserted, that the school grants to those States have been otherwise than liberal, if not prodigal. Ohio, Indiana, Illinois, Missouri, Alabama, Mississippi, Louisiana, Michigan, Arkansas, Florida, Iowa, and Wisconsin were granted one section in a township for school purposes; California, Minnesota, Oregon, Kansas, Nebraska, Colorado, Washington, the Dakotas, Montana, Idaho, Wyoming, and Oklahoma, two sections; and Utah, New Mexico and Arizona, four sections; donations ranging, in area, from one thirty-sixth to one-ninth of the State, and, in round numbers, from 1,261 square miles in the case of Louisiana, to 13,945 in that of New Mexico, the latter area greater than that of Massachusetts or Maryland.

"Below is a statement showing the area, in acres, of the land granted for educational and other purposes to the 10 States materially affected by the proposed legislation. The first column gives the total acreage, the second the area of school sections in place, and the third the area of school sections not yet surveyed:

"It should not be overlooked, in any consideration of this question, that a State is more than indemnified for the so-called 'loss' of school land in place, because of its mineral character. The State has the right to take other land, non-mineral in character, of equal area, and it receives in addition, under the general leasing act, 37½ percent of the rents and royalties from all minerals within its borders, while 52½ percent of such rents and royalties go to the fund for reclaiming Western desert lands.

"This department has long been aware that the grant of school land, in place, to the several States was faulty in that no authority was vested in it, as under other laws, to issue patents or other evidences of title, and has repeatedly called this defect to the attention of the Congress. On August 9, 1913, there was introduced a bill, S. 2911, 63rd Congress, first session, 'further to assure title to lands granted the several States, in place, in aid of public schools.'

"This bill failed of enactment. Probably this was due to the pendency in the courts, at that time, of the celebrated Sweet case, afterwards terminated by the decision of the Supreme Court, reported in 245 U. S., 563, in which the departmental construction of the school grant was sustained, and it was reiterated that the exception of mineral lands from that grant was the settled policy of the law.

"Though the department thereafter, from time to time, in its anual reports, called attention of the Congress to the need of legislation with respect to this matter, nothing was done. In the present Congress there has been a renewal of interest in the subject, as is evidenced by the introduction of some 14 bills.

Compact With the States

"All the public land States interested, before being admitted into the Union, entered into a compact with the Government that they would not interfere with the dispo- (*Continued on page* 550)

State	Total Granted	School Sections	Unsurveyed
Arizona	10,489,236.00	8,093,156.00	996,750.00
California	8,422,664.18	5,534,293.00	221,256.00
Colorado	4,433,378.00	3,685,618.00	55,120.00
Idaho	3,631,965.00	2,963,698.00	104,618.00
Montana	5,869,618.00	5,198,238.00	20,220.00
New Mexico	12,406,026.86	8,711,324.00	216,360.00
Oregon	4,352,132.66	3,399,360.00	11,415.00
Utah	7,414,276.00	5,844,196.00	1,728,920.00
Washington	3,044,471.00	2,376,391.00	726.00
Wyoming	4,138,569.00	3,470,009.00	26,539.00
	64,202,337.00	49,276,283.00	3,381,919.00

ANNUAL CONVENTION NATIONAL COAL ASSOCIATION

National Coal Association Convention At Chicago Opposes Government Regulation Of The Industry—Mine Safety Activity Recommended—Walter Barnum Elected New President—Discussions Cover Wide Variety Coal Problems

A POSITIVE declaration against Government regulation of the coal industry as proposed in pending bills before Congress was made by the National Coal Association at its annual convention at Chicago in June. There was unanimous sentiment on the part of several hundred representatives of the bituminous industry against compulsory fact findings and restrictive regulation of the industry by Federal agencies. On the other hand, the association reaffirmed its position to collect within the industry detailed information as to production and distribution in order to promote orderly processes in the trade. Recognizing the need for vigilance against recurring mine disasters, the association pledged itself to work actively in behalf of mine safety measures.

The association selected as its president one of its young and aggressive leaders, Walter Barnum, who is the president of the Pacific Coast Co., and who has been long identified in an active way within the councils of the organization. Mr. Barnum has been a vice-president and director of the association and actively interested in its research work for the better use of coal, and has appeared before legislative bodies on proposed coal legislation, more recently before the House Committee on Interstate Commerce in opposition to the Government regulation bill. Charles E. Bockus, president of the Clinchfield Coal Corporation, of New York, and chairman of the trade information committee of the association, was elected treasurer, and Harry L. Gandy reelected secretary. The following were elected vice-presidents: Ira Clemens, president of the Clemens Coal Co., Pittsburgh; Michael Gallagher, general manager of the M. A. Hanna Co., Cleveland; George B. Harrington, president of the Chicago, Wilmington & Franklin Coal Co., of Chicago; and E. C. Mahan, president of the Southern Coal & Coke Co., of Knoxville.

A brilliant array of speakers well known in the coal industry delivered addresses on topics of timely interest to the industry. These discussions embraced many phases of coal operation, marketing, and financing.

"Economic problems affecting the industry can not be solved by the kind of legislation proposed," declared Secretary Gandy in his annual report, in which he reviewed the status of pending coal legislation before Congress. "The setting up of a body political to which either side of an industrial controversy may appeal will make practically certain that employers and employes will not voluntarily agree."

The association paid a touching tribute to its former president, Col. Daniel B. Wentz, of Philadelphia, who died this winter while serving as president of the American Mining Congress. "In the passing of Colonel Wentz, the association lost an able and efficient worker and the industry an upstanding operator," said Walter H. Cunningham, of West Virginia, chairman of the government relations committee. "His counsel and advice will be missed."

Walter Barnum, elected President of the National Coal Association

Safety Organizations

An interesting report was made by a safety committee of the association in which it was stated that the American Mining Congress is among 23 organizations and agencies in the country whose work is actively concerned with safety measures.

The association was told by Mr. Clemens, chairman of its transportation committee, that that committee had no occasion during the year to hold a meeting because of the efficiency of the transportation system of the country. "There are ample transportation facilities to meet the needs of the industry for some time in the future," he said.

Chairman Bockus, of the trade information committee, said the association is encouraging the establishment of statistical work by local associations in order to secure for compilation by the national association reports which will represent conditions throughout the industry. The first reports to be collected are as to past sales, information of this character being conducted in West Virginia, Kentucky, Virginia, and Alabama.

"The bituminous mining industry is highly competitive," said Mr. Bockus. "As a result, too much coal is being marketed at unremunerative prices, often at less than production cost. Figures on the geographical distribution of coal from different fields will serve a useful purpose in assisting operators to determine in what consuming territories to place their products. Other lines of statistical activity should cover transportation, safety measures required by law or installed by other companies, taxation, insurance, credit, improved burning methods, and new uses for coal and its by-products. We oppose any system of compulsory reporting to a Federal agency, not from a desire to conceal facts but because such action will prove the first step in the direction of Federal regulation."

Coal Research

An interesting address was made by Mr. Barnum on the value of research to the coal industry. "Research is an orderly attack on unknown factors in a problem," said Mr. Barnum. "Research involves a knowledge of human and physical factors." He referred to the graduate research fellowships established by the association, and presented to the convention Russell B. Cooper, of Johnstown, Pa., who is conducting research work under one of these fellowships. Reference was also made by Mr. Barnum to the work of the advisory committee of the association with the Massachusetts Institute of Technology on a graduate course in fuel and gas engineering.

Summarizing the research work of the association, Mr. Barnum said it covered studies of American coals; boiler fluids other than mercury; properties of coke; and combustion of gases.

Coal Buying Power

The buying power of the bituminous industry was discussed by Allen H. Wil-

Banquet, Ninth Annual Meeting of the National Coal Association

lett, director of the bureau of coal economics of the association. "The bituminous mining industry, instead of assuming an apologetic attitude in the face of hostile criticism, is justified in pointing with pride to its history and present performance," said Mr. Willett. "The record of its achievement stands comparison with that of any other industry. Industrial establishments and domestic consumers have been furnished with an unlimited supply of fuel at a price lower than that paid in any other country. The industry has maintained a constant supply of fuel, enabling manufacturing, mining, and transportation enterprises to proceed with development and operation plans with confidence in their ability to obtain adequate supplies of fuel. Its record in the anthracite shortage illustrates the ability of the bituminous industry to serve the country in time of need." Mr. Willett spoke of the mutual interdependence of the bituminous industry and the railroads. He advocated cooperative buying of mine supplies and the maintenance of a common store of surplus materials by the bituminous industry.

Mine Safety

A number of interesting addresses on mine safety were delivered, including one on the human element in safety work, by Phil. H. Penna, of Indiana, chairman of the safety committee of the association. "The safety movement is deserving of the hearty support of coal operators," said Mr. Penna. "Our goal should be nothing short of elimination of all preventable accidents."

W. A. Ellison, general manager of the Southern Harlan Coal Co. and president of the Harlan County Coal Operators' Association, spoke of the advantages and benefits to be gained from centralized accident reports. He explained this system, which had been established by the Harlan County Operators' Association.

J. William Wetter, general manager of the bituminous operations of Madiera Hill and Co., delivered an address on reducing hazards in coal mining, covering experiences in the mines of that company during the past two and one-half years. He pointed out that the system employed by the company in promoting safety has developed a spirit of cooperation on the part of the employes and enables the company to exercise strict discipline in enforcing its safety regulations and the Pennsylvania state mining law. In less than a year and a half the company has eliminated 50 percent of its ccidents.

Measures to interest miners in safety work were outlined by R. E. Howe, vice-president of the Climax Coal Co., and secretary of the Southern Appalachian Coal Operators' Association of Knoxville. He said safety involved safety of men, machinery, and supplies, and mining investment. He spoke of the formation by the association of an efficiency organization to promote mine safety through instruction and contests. He stated that cooperation in mine safety can best be had by mass meetings.

Methods to keep the cost of compensation insurance to the minimum were explained by J. T. Rupli, superintendent of the compensation department of the Chicago, Wilmington & Franklin Coal Co. This involved, he said, medical examination of employes to determine their fitness for efficient work, and the placement of an injured employe after his recovery in a position in the mine suitable to his abilities. Pool buying was discussed by John C. Dinsmore; associated purchasing, by Walter Muir, of the Raleigh Coal & Coke Co., and the New River Coal Operators' Association of West Virginia; coal salesmanship, by Ralph Knode, president of the General Coal Co., of Philadelphia; centralizing sales agencies, by H. A. Glover, vice-president of the Knox Consolidated Coal Co., of Indianapolis; and the layman's viewpoint of coal, by Melvin Traylor, president of the First National Bank and First Trust and Savings Bank of Chicago.

MOTHER LODE SECTION ORGANIZED

(*Continued from page* 483)

12.—*Vote of Thanks:*

That the section does hereby extend a vote of thanks to the Department of Mines and Mining of the Sacramento Chamber of Commerce for its cooperation and assistance in the formation of the California Mother Lode Chapter of The American Mining Congress.

The program outlined for future activities of the section is an ambitious one, and includes committees on the following:

Membership, Finance, Publicity; (a) On meetings of section, (b) eventually, official Mother Lode organ; *Program and Convention,* (a) Prepare programs for regular meetings, (b) Arrange for annual convention, (c) Arrange for participation in mining; *Standardization,* (a) Improved mining methods, (b) Better milling and metallurgical treatments, (c) Mine timbering and water control, (d) Mine ventilation, (e) Transportation—within mines and to mines; *Gold Production,* (a) stimulation of gold mining, (b) Solution of peculiar problems of gold industry; *Industrial Minerals,* (a) Development of non-metallics of Mother Lode; (b) Expansion of base metal production on Lode.

Mine Taxation, (a) Federal—elimination of taxes on gold, (b) State—lessening of present taxation, (c) County—Stabilization of taxation methods and elimination of tax on ore reserve; *Mine Labor,* Lessening of immigration restrictions; *Legislative,* (a) Establishment of State Department of Mines, (b) Opposing detrimental state bills, (c) Cooperating with Washington headquarters in protecting industry against oppressive Federal Laws, (d) Obtaining law requiring filing of mine reports, (e) Enforcement of high-grading law, (f) Securing Federal legislation to aid hydraulic mining; *Mine Safety,* (a) Safety measure in mines, (b) Improved compensation insurance methods.

PRESERVATION OF MINE TIMBER

A STUDY of mine timber preservation has been undertaken at the Athens mine of the Cleveland Cliffs Iron Co., in northern Minnesota, by F. C. Gregory, resident engineer, Bureau of Mines. Observations will be made of mine timbers specially treated and placed in the mine. Records will be kept of temperature, humidity, conditions of other timbers, source of air currents in drifts where timbers are placed, and other data which might have a bearing on the life of the treated timber.

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

GUY N. BJORGE, Editor

Practical Operating Problems of the Metal Mining Industry

FLOTATION PROGRESS AT BRITANNIA

A Description Of The Flotation System Used At Britannia—Flotation Dependent Upon Nature Of Surface Of Particle—Special Equipment Necessary To Prevent Detrimental Oxide Film—Results Obtained Indicate Distinct Advance In Flotation

By A. C. MUNRO AND H. A. PEARSE *

AT BRITANNIA BEACH, within 30 miles of Vancouver, on the shores of Howe Sound, one of the innumerable narrow inlets which indent the coast line of British Columbia, is situated the copper concentrating plant of the Britannia Mining and Smelting Co. The main portal of the mine is about two and a half miles inland, at an elevation of 2,100 feet above sea level.

The present concentrator, which replaces one destroyed by fire in 1921, was completed and began to operate in February, 1923. The mill building and foundations, constructed entirely of concrete and steel, are located on a 45-degree rock slope, which arrangement permits of gravity flow throughout the mill. As originally designed, the rated capacity was for 2,000-2,500 tons, but with certain modifications this has been increased to well over 3,000 dry tons daily at the present time.

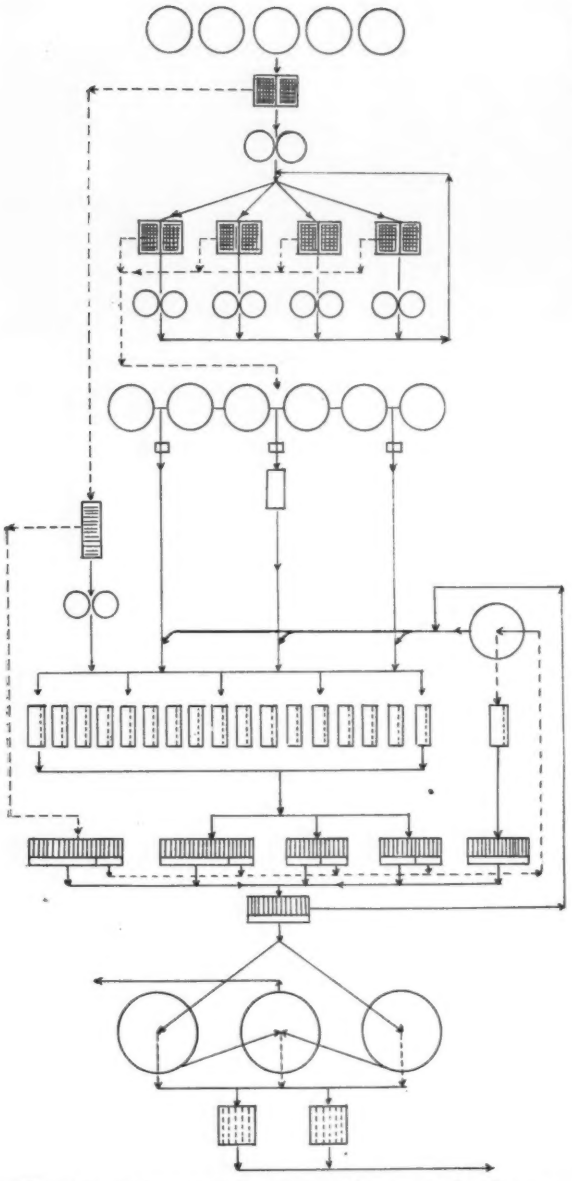
The ore consists of a mixture of chalcopyrite and pyrite as the principal minerals in a hard quartz porphyry gangue, which is often changed to a quartz mica schist spotted with films of chlorite. Mineralization is of the nature of impregnation and replacement of the schist. The ore also contains a small percentage of zinc blende, as well as low gold and silver values, and in various parts of the mine are found isolated occurrences of galena and non-metallic minerals such as gypsum, calcite, magnesite, and barite.

The various sulphides can be fairly easily ground free from one another and from the gangue, so that it is unnecessary to resort to very fine grinding. The gold appears to be largely in the free state, either in the quartz or loosely associated with the chalcopyrite or pyrite. The silver is mostly intimately associated with the chalcopyrite, but there is also evidence to indicate that a smaller amount is closely associated with the pyrite.

Britannia Mill. Showing power house in center and passenger and freight incline railway to mine. Mine entrance in valley at extreme upper left

The ore in place is practically free from oxidation, but the application of the shrinkage stoping method in sections of the Britannia mines necessarily maintains a large tonnage of broken ore in these stopes, much of which consequently becomes superficially oxidized before finally reaching the mill. The admixture of such ore with other freshly broken complicates

*Mill Superintendent and Metallurgist, Britannia Mining & Smelting Co., Ltd.


5—500-Ton Coarse Ore Bins
4—Hummer Washing Screens
1—Set 72" x 20" Traylor Rolls
8—Hummer Dry Screens
4—Sets 54" x 20" Traylor Rolls
6—600-Ton Fine Ore Bins
3—Merrick Weightometers
1—Roller Rod Mill
1—7' x 16' Drag Classifier
1—Set 42" x 16" Traylor Rolls
1—20' Dorr Thickener
18—7' x 10' Traylor Mills, each with 3' x 20' Simplex Dorr Classifier in closed circuit
3—14 and 2—21-Cell M. S. Roughers
1—14-Cell M.S. Cleaner
Overflow to waste
3—44' x 14' Door Thickeners
2—6-Leaf American Filters
Concentrates to Storage

Flow Sheet No. 3 Mill Britannia Mining and Smelting Co., Limited, June 10, 1926

the treatment required to secure a satisfactory recovery of the copper in the present mill feed.

In times past only those ores in which quite appreciable percentages of oxides or carbonates were found were considered as oxidized, and therefore wholly or partially unfavorable to flotation treatment. However, as the latter art has become more thoroughly developed and understood, it has been realized that it is the nature of the surface of a mineral particle which is the controlling factor in the recovery or rejection of such a particle by the flotation process. When it is considered that a partial oxide film of even monomolecular thickness may render a mineral particle partially or completely inert to flotation, the importance of milling ore as soon as possible after breaking, or at least protecting broken ore from even slight oxidation, becomes evident. However, either of these courses is not always practicable, so that the metallurgist must adapt his treatment to the existing circumstances. It is also common knowledge among flotation operators that the soluble salts which are always found to be present in oxidized or semi-oxidized ore, according to their nature, exert a more or less detrimental effect on the results. Experimental work in the laboratory during the first year of operation of the new mill disclosed the fact that the most refractory portion of the mill feed was the primary slimes—that is, the material through or closely approaching 200 mesh in fineness. This finding is in accord with the quite commonly accepted theory of superficial oxidation as mentioned above.

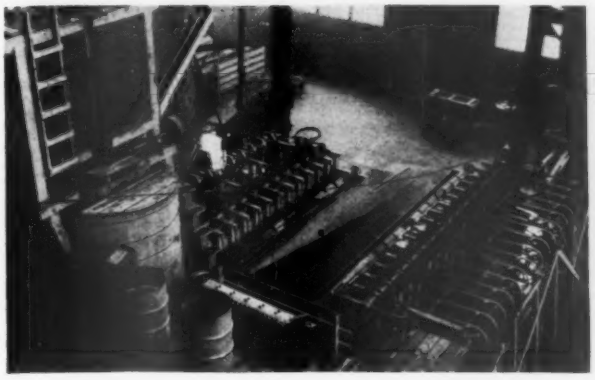
The minus 200 mesh material constituted about 10 percent of the total mill feed, but contained at least 20 percent of the total copper, so it was decided to modify the flow sheet to permit the segregation of the primary slimes in order that they might be given special flotation treatment. Another advantage in this scheme is that practically all the soluble salts are also segregated with the slimes and thus prevented from contaminating the major portion of the mill feed. This phase of the operation is subsequently discussed in greater detail.

The "All Flotation" flow sheet, as outlined herein, is the outcome of three years of continual research, both in the laboratory and in the mill itself. Although many modifications have been made in the flow from time to time, the equipment in use is practically the same as originally installed, except that jigs were discarded with the introduction of differential flotation.

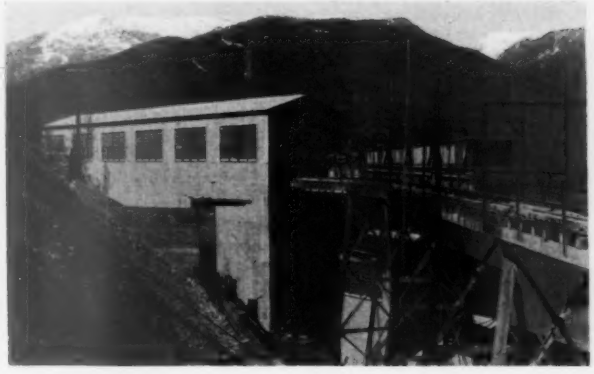
Crushing and Fine Grinding

Ore from receiving bins previously crushed at the mine to pass a 2½-in. ring is thoroughly washed by means of high pressure sprays to remove adhering slimes and the finer material up to 3-16-in. is removed by Hummer screens. This washing and screening process serves a double purpose inasmuch as that portion of the ore which contains the primary slimes and soluble salts is segregated, and also since the oversize is free from adhering slimes, difficulties, due to choking of rolls and blinding of dry screens, are practically obviated. The oversize from the Hummer screens, mentioned above, is reduced by means of one set of 72x20-in. and four sets of 54x20-in. Traylor rolls to 3-16-in. and passed to fine storage bins. The undersize is sent to a drag classifier, the overflow from which, containing practically all the primary slimes and soluble salts originally in the ore, is sent directly to one flotation rougher. The underflow unites with feed from fine bins passing to 17 7x12-ft. Traylor mills in parallel, each operating in closed circuit with a Simplex Dorr Classifier. The finely ground ore is then distributed to four other flotation roughers.

Fine grinding equipment has recently been increased by the addition of a 42x16-in. Traylor roll and a 7x12-ft. tube mill, which latter is utilizing as grinding media obsolete 41-in. shells carrying a rod load. Both these machines are being used to reduce the coarser portion of the feed from the fine bins before it passes to the ball mills.



Pilot Plant. Capacity 1 ton per hour. Total cost, $1,300



Ore train entering roll plant. Nine car trains are now used instead of four as shown

The ore is ground to 26-28 percent plus 65 mesh, which suffices to free all but a very small percentage of the chalcopyrite from the gangue and other minerals. The hard nature of the gangue in the Britannia ore may perhaps best be judged by the fact that the cost of carbon consumed in diamond drilling is $1.60 per foot. This figure was obtained from the cost of over 5,000 feet drilled in various parts of the mine. The dilution in the ball mills is maintained at approximately 65 percent solids, this being increased to 18 percent solids before the pulp enters the roughing machines.

Flotation Roughing

Roughing equipment consists of five machines of the standard M. S. type—three of 14 cells and two of 21 cells each. With the exception of one of the 21 cell machines, which is reserved for treating the primary slimes, each of these roughers is handling between 700 and 800 tons daily, which considering the recovery obtained, is quite a remarkable performance. Previously to its entering the roughing circuit the pyrite in the ore is deadened by the addition of hydrated lime to the ball mills, the consumption of this reagent on the washed ore averages about 1.6 pounds per ton. The lime is fed from a very slowly moving conveyor into an agitating tank, and thence distributed in solution or suspension by pipe lines to each mill.

For the collecting reagent, either potassium xanthate or an oil mixture consisting of 80 percent coal tar—20 percent Canadian hardwood creosote, is used with almost equal success. The xanthate gives a slightly cleaner and higher grade concentrate, but for this reason, due to the lack of fine insoluble matter, the concentrate settles very rapidly, and is difficult to pump and filter. The copper recovery is approximately the same with either reagent, but the coal tar mixture appears to give a very slightly better recovery of the free gold. The consumption of the coal tar mixture, which is always added at the ball mills, averages about .35 pounds per ton. When xanthate is used in place of the coal tar mixture, it is added directly at the head of each rougher, the addition at this point equalling .01 pounds per ton which is a very low consumption, but flotation records have indicated that the use of a larger quantity tends to float pyrite without increasing the recovery of the copper. In experimental tests the xanthate has also been added with the ore entering the grinding mills, but there appeared to be no advantage in adding this reagent so far ahead of flotation.

For frothing purposes there is added at the head of each rougher .13 to .15 pounds per ton of steam distilled pine oil. In order to stabilize the somewhat brittle froth produced under existing conditions, there is also added both at the head and at points farther along the roughers a very small quantity of sodium resinate. This reagent is made locally from resin and commercial caustic soda.

Scavenging Treatment

Early in 1925 some research was carried out which showed that a further addition of xanthate and pine oil toward the end of the roughing period greatly enhanced the recovery of the copper, but also tended to float considerable of the previously deadened pyrite. However, it was found that the pyrite could be again deadened by regrinding with lime. As a result, the flow sheet was modified as follows:

At the sixth cell from the tail end of roughers a further addition is made of

Standard M. S. Flotation Machines

Concentrates in storage. Showing clamshell, apron feeder and conveyor for loading concentrates on vessel

.03 pounds xanthate and .10 pounds of pine oil. This has the effect of floating a low grade concentrate consisting mainly of pyrite and averages approximately 2 percent copper. This product, after thickening is reground with lime in one of the mills and returned to one of the roughing machines where it is treated together with some fresh feed and the copper mineral thus separated from the pyrite. No scavenging action is effected on the rougher which treats the returned pyrite concentrate, because this would involve floating the redeadened pyrite a second time, and a continually increasing circulating load of this mineral would be built up in the system.

The following advantages may be claimed for this so-called scavenging treatment:

(1) A much stronger flotation effect can be maintained on the tail cells of roughing machines than would otherwise be possible if it were necessary to maintain differential conditions during the whole time in which the pulp is passing through the machine.

(2) Mineral particles consisting of a mixture of chalcopyrite and pyrite are readily floated, and the copper which is set free in the subsequent regrinding is thus recovered, whereas without the scavenging treatment there was at least a 50-percent chance of such copper going into the tailings due to it being combined with pyrite which had been previously deadened. It will be recognized that this permits somewhat coarser initial grinding than would otherwise be necessary in order to obtain the same recovery.

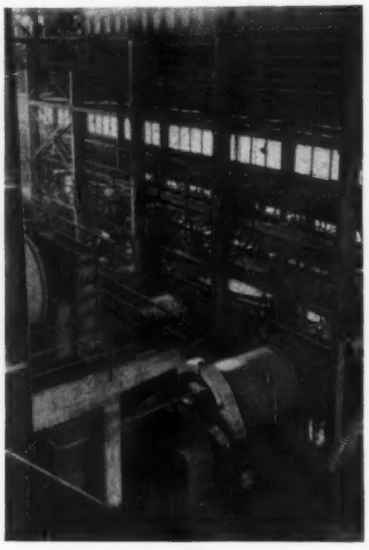
(3) A third incidental advantage is that the strong flotation conditions constantly maintained on the tail cells acts as a safety device in case of short periods of irregular operation.

It is noteworthy that since the introduction of this scheme into the flow sheet recovery has been increased by over a pound of copper per ton of tailings.

Treatment of Primary Slimes

As previously noted, the overflow from the drag classifier containing practically all the original primary slimes and soluble salts in the ore is laundered directly to one M. S. rougher. Assays of this material for "oxide" copper checked by two dependable methods indicate the presence of .01 to .05 percent. Although this represents a relatively small amount of oxidized copper, yet if considered as a film coating on fine mineral particles would render a large number of such particles partially or completely inert to flotation.

Analyses of average samples of the water decanted from the slimes entering the flotation machines gave results as shown in Table No. 1. All the soluble salts found to be present in appreciable amounts were added to charges of clean freshly broken ore in the laboratory test machine in order to determine the effect of each. Assays of concentrates and tailings for each salt tested are shown in Table No. 2. The equivalent of 3 pounds per ton of the reagent was added in each test.



Upper and lower tube mills showing crane serving floors

TABLE NO. 1.—ANALYSIS OF WATER DECANTED FROM PRIMARY SLIMES

Salt	Grams per Litre	Pounds per ton of Water	Equivalent pounds per ton of slimes
FeSO4 Al2(SO4)3 Fe2(SO4)3	.27	.54	3.45
ZnSO4	.03	.06	.38
CaSO4	.62	1.24	7.90
MgSO4	.10	.20	1.28

It will be observed that calcium sulphate, which is present in the largest quantity, is also the salt most detrimental to recovery. The sulphates of aluminum magnesium, ferrous iron and zinc are also shown to be decidedly harmful, but are present in smaller quantities than CaSO4. Moreover, lime is added to the primary slimes some distance ahead of flotation, always in sufficient quantities to maintain an excess of free alkalinity, so that these latter sulphates are precipitated as insoluble hydrozides, and therefore prevented from interfering in the flotation machine.

Calcium sulphate is, however, more difficult to eliminate, although laboratory flotation tests have shown that the harmful effects of this salt are to a great extent neutralized by the addition of lime. It is believed that this is due to the solubility of the CaSO4 being decreased by the common calcium ion effect when lime is also present. Attempts to precipitate the CaSO4 with such reagents as sodium silicate have not proven very successful. On these primary slimes potassium xanthate is used exclusively as the collecting reagent, the consumption averaging approximately .2 lbs. per ton of slimes treated. Due to the oxidized nature of the pyrite in the slimes, this mineral shows very little tendency to float even when such a relatively large quantity of xanthate is applied. For frothing purposes, a mixture of 7 percent Pine oil—25 percent Fumol is used. Fumol, an aldehyde by-product from the manufacture of acetaldehyde and acetone, appears to be of particular value in treating ores which are partially oxidized, and it possesses collecting as well as frothing properties. However, as it is an expensive reagent, the cost would be almost prohibitive if used on the whole tonnage instead of on the segregated slimes only.

From the foregoing discussion it will be seen that the segregation of the slimes not only limits the detrimental effects of soluble salts, particularly CaSO4, to a small tonnage, but also permits the use of special, and larger amounts of reagents than would be advisable or necessary on the major part of the ore treated. It may be remarked that even so the tailings on the primary slimes rougher average .20-.30 percent Cu as compared to .10 on the other machines, which treat the washed ore.

If insufficient lime is added to the primary slimes, the tailings may increase to .7 percent Cu or even higher according to the nature of the ore. This point illustrates the general usefulness of lime as a flotation agent, not only to inhibit the flotation of pyrite, but also to enhance the recovery of other minerals.

TABLE NO. 2.—EFFECT OF SOLUBLE SALTS ON FLOTATION

Soluble Salt Added	Concentrates Percent Cu.	Tailings Percent Cu.	Percent Recovery
Blank—with Distilled Water	8.3	.17	90.0
Pure Lime—Ca(OH)2	15.1	.15	91.2
Zinc Sulphate—ZnSO4	14.4	.30	82.4
Aluminium Sulphate—Al2(SO4)3	12.5	.21	87.6
Ferrous Sulphate—FeSO4	16.5	.44	74.0
Ferric Sulphate—Fe2(SO4)3	12.2	.16	90.6
Magnesium Sulphate—MgSO4	12.7	.44	74.0
Calcium Sulphate—CaSO4	17.5	.56	67.0

Cleaning

The concentrate product from all rougher cells, except the last six on each

TABLE NO. 3

	May, 1923	May, 1926
Ratio of Concentration	6.6	14.2
Percent Recovery—Copper	89.60	92.13
Percent Recovery—Gold	66.80	55.0
Percent Recovery—Silver	65.50	43.5
Reagents—Lbs. per ton		
Hydrated Lime	..	1.74
Coal Tar	.80	.27
Hardwood Creosote	.26	.07
Pine Oil	.25	.25
Potassium Xanthate	....	.034
Fumol	....	.01
Sodium Resinate	....	.01
Cost per ton—Cents	4.88	5.0
Grinding Media—Consumption		
Danish Pebbles—		
Lbs. per ton	10.0	....
Cents per ton	10.3	....
Rail Balls—		
Lbs. per ton	....	2.65
Cents per ton	....	5.30
Power Consumption—		
K. W. H. per ton	16.3	17.3
Tons milled per man shift	43.0	89.0
Total Mill'g Cost Cts. per ton	71.7	42.5

machine, is subjected to a cleaning operation. This is accomplished in a 14-cell machine similar in all respects to the standard M. S. roughers. No fresh oils or reagents are added at this point as there is always quite sufficient oil in the middlings to maintain a copious froth. The slowness of response to flotation of the copper mineral in even the washed portion of the ore at present being treated makes it imperative that the strongest flotative influence be brought to bear throughout the entire roughing period in order to make a satisfactory recovery. This therefore entails the floating of a certain quantity of pyrite into the middlings and cleaning may be considered as not only a means of eliminating silica, but also as an aid to reducing the pyrite content of the finished concentrate. In this connection the present Britannia flow sheet is defective, inasmuch as pyrite once floated on the roughers tends to float again immediately upon its entrance to the cleaner. It is proposed to remedy this defect by regrinding the middlings with lime before cleaning. Experimental results in the laboratory, and in pilot tests conducted in the mill, have demonstrated that such a modification of our flow sheet would result in deadening the once floated pyrite to the extent that the greater elimination of this mineral would make possible an increase of at least 5 percent in the cleaner concentrate grade over that at present obtainable.

Cleaner tailings are pumped to a small tank, and thence distributed by gravity flow to the head of each of the grinding mills. The water takes the place of the head water which would otherwise be used on the mills, and by this regrinding of the cleaner tails, any chalcopyrite still combined with pyrite is set free, and the latter mineral is again deadened before it re-enters the roughing circuit.

Metallurgical Control of Operation

All the flotation machines are placed on the same level in two banks on each side of a central passageway. This arrangement makes necessary only one operator per shift, which in addition to the saving in labor cost, has the advantage of undivided responsibility for maintaining satisfactory results.

Alkalinity is controlled by titrating the tailings water from each rougher with a weak sulphuric acid solution every two hours. The amount of lime which must be added varies frequently according to the changes in the natural acidity of the ore.

A small laboratory adjacent to the flotation floor has been provided, and samples of the tailings and concentrates from each rougher and the cleaner are taken every two hours. Tailings are assayed by the color and concentrates by the fluoride-iodide methods, which are both rapid, so that in half an hour after the samples are taken, the results are in the hands of the operator who can immediately make any required adjustments. It has been found that this procedure tends to eliminate the personal element and promotes consistent operating results.

TABLE NO. 4.—SCREEN ANALYSIS; COMPOSITE FLOTATION CONCENTRATES; FOR MAY, 1926

Mesh		COPPER					IRON			INSOLUBLE		
		Pct. Wt.	Acc. Pct. Wt.	Pct. Cu.	Pct. Wt. Cu.	Acc. Pct. Wt. Cu.	Pct. Fe.	Pct. Wt. Fe.	Acc. Pct. Wt. Fe.	Pct. Ins.	Pct. Wt. Insol.	Acc. Pct. Wt. Ins.
On	65	1.5	1.5	21.97	1.6	1.6	27.2	1.4	1.4	17.0	3.9	3.9
On	100	4.5	6.0	21.56	4.6	6.2	31.4	4.8	6.2	12.1	8.4	12.3
On	150	10.0	16.0	20.75	9.8	16.0	32.0	10.8	17.0	7.1	11.1	23.4
On	200	12.0	28.0	20.54	11.7	17.7	33.6	13.6	30.6	6.2	11.5	34.9
Through	200	72.0	100.0	21.15	72.3	100.0	28.5	69.4	100.0	5.8	65.1	100.0
Totals		100.		21.07	100.0		29.5	100.0		6.4	100.0	

SCREEN ALALYSIS; COMPOSITE FLOTATION TAILINGS; FOR MAY, 1926

Mesh		COPPER					IRON		
		Pct. Wt.	Acc. Pct. Wt.	Pct. Cu.	Acc. Pct. Cu.	Pct. Wt. Cu.	Acc. Pct. Wt. Cu.	Pct. Fe.	Pct. Wt. Fe.	Acc. Pct. Wt. Fe.
On	35	4.5	4.5	.21	.21	6.4	6.4	1.9	1.8	1.8
On	48	8.0	12.5	.17	.18	9.3	15.7	1.6	2.9	4.7
On	65	15.5	28.0	.14	.16	14.9	30.6	2.0	6.9	11.6
On	100	12.7	40.7	.12	.15	10.4	41.0	3.3	9.4	21.0
On	150	10.3	51.0	.10	.14	7.1	48.1	5.0	11.4	32.4
On	200	9.3	60.3	.09	.13	5.7	53.8	6.0	12.3	44.7
Through	200	39.7	100.0	.17	.15	46.2	100.0	6.2	55.3	100.0
Totals		100.	.	.15	.	100.0		4.4	100.0	

TABLE NO. 5.—COMPOSITE TAILINGS

Mesh		Pct. Material	Pct. cu.	Pct. of Total Copper Loss	Pct. Oxide Copper
On	65	28.0	.16	30.6	.0057
Through	65 on 200	32.3	.10	23.2	.0065
Through	200	39.7	.17	46.2	.0181
Total		100.0	.15	100.0	.0105

TABLE NO. 6.—SEPARATION OF CHALCOPYRITE AND ZINC BLENDE

Samples—Pilot Plant—Feed 1 Ton per Hour	Pct. Material	Pct.Cu.	Pct. Zn.
Head—Concentrates from thickeners	100.0	19.1	8.3
Copper Concentrate	48.0	32.0	2.6
Middling	20.0	17.9	19.4
Zinc Concentrate	6.0	3.7	50.2
Residue—Mainly Pyrite and Silica	26.0	0.35	0.8

Note: In these tests it was found that the gold and silver always concentrated with the chalcopyrite.

Mill Performance

In Table No. 3 is shown a summary of the essential details of milling results for May, 1926, as compared with those of May, 1923, when the mill had been in operation for only three months. This was before differential flotation had been begun as indicated by the low ratio of concentration secured when the pyrite was not inhibited from floating with the copper mineral. Under present conditions of operation approximately 86 percent of the pyrite is eliminated from the finished concentrates.

The increase in copper recovery is worthy of note, especially as the ore being treated at the present time is more oxidized and therefore less readily amenable to flotation than in 1923.

Reference to Table 4, showing screen analyses of flotation concentrates and tailings reveals the fact that 46.2 percent of the total copper loss in the tailings occurs in the minus 200 mesh material, while in the material through 65 on 200 mesh the loss is only 23.2 percent. In this regard the figures shown in Table 5 are very interesting.

The assay for oxide copper was carefully checked by two different methods.

It will be noted that the oxidized copper is approximately three times as great in the minus 200 as in the other mesh material. This copper is undoubtedly ground free, and is fine enough to float readily, so that it would seem that the reason that such copper mineral does not float is on account of it being coated with a thin film of oxide. In the next coarser screen size, where the copper mineral is ground comparatively fine, and not nearly as highly oxidized, the copper loss is very low. The loss in the plus 65 mesh is, of course, largely due to insufficient grinding to free the mineral from the gangue. Nearly all this oxidized copper in the minus 200 mesh material originates in the primary slimes in the ore, as it comes from the mine. The segregation of these slimes, by means of the drag classifier in order that they may be subjected to special flotation treatment, has undoubtedly been a considerable aid in dealing with partially oxidized ore.

It will be noted that the present recoveries of gold and silver are 55 percent and 63.5 percent respectively. Part of the gold and practically all of the silver loss is with the rejected pyrite and therefore beyond the mill control. It may be remarked, however, that there is in the tailings a small percentage of fine free gold which appears to be very difficult to recover by flotation.

Milling Costs

Another point of interest in connection with the Britannia milling operation is the exceptionally low cost. The total cost in cents per ton, including primary crushing and royalties was 42.5 for May, 1926. Excluding the cost of the underground crushing operation at the mine, and royalties, the direct cost for 1926 to date covering all operation, maintenance, and renewals for the mill itself was 35.2 cents per ton.

The chief factors contributing to this low cost are:

(1) Power, not exceeding .5 cents per K. W. H.

(2) The use of grinding balls locally made from scrap rails.

(3) Low labor cost per ton of ore milled.

(4) Use of "Britannia" lining in mills (i.e., rail sections set on end in neat cement.)

(5) Increasing of the thickness of roll shells from 5 inches to 8 inches.

(6) Low cost of flotation oils and reagents per ton of ore milled.

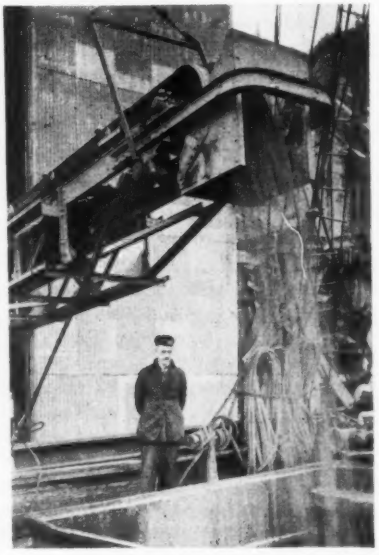
Zinc Separation

The ore from all parts of the Britannia mine contains small percentage of zinc blende, and in some localities the percentage is relatively high. During the early part of 1925 it was observed that the zinc content of the mill concentrates was steadily increasing and rapidly approaching the smelter penalty limit. Since this condition appeared at that time likely to continue the research department undertook to investigate the possibilities of making a separation of the zinc blende into a marketable concentrate.

The experimental work in this connection was carried to a successful conclusion, but has not been applied in mill operation for the reason that a survey of the zinc reserves of the mine conducted concurrently with this experimental work, disclosed the fact that there was not available a tonnage of copper ore sufficiently high in zinc to warrant the installation of the necessary additional equipment. However, since the subject may be of interest to anyone who is treating a copper ore containing zinc, a brief summary of the treatment evolved is included herein.

Owing to the very small percentage—about 1 percent or less of zinc in the crude ore, as well as to the fact that the zinc mineral readily concentrated with the chalcopyrite under existing conditions of flotation, it appeared advisable to attack the problem from this angle rather than to try and make a separation in the primary roughing circuit.

Consequently tests were conducted on the partially de-watered concentrates from the underflow of the Dorr thickeners. After exhaustive tests with other reagents, which were not successful, it was found that by regrinding the concentrates with approximately .5 lbs. per ton of sodium cyanide, the zinc blende could be sufficiently deadened to permit the flotation of a high grade copper concentrate low in zinc. After removal of the chalcopyrite the blende was floated by the addition of approximately .5 lbs. $CuSO_4$. The pyrite in the original concentrate is of course also deadened by the cyanide and remains in the tailings which in actual operation would be returned to the primary roughing circuit to recover any remaining values which they might contain.



Concentrates being loaded on vessel for shipment to Tacoma smelter

A mixture of 75 percent cresylic acid —25 percent coal tar, was finally adopted as the most satisfactory reagent for floating the copper concentrate, while the blende was floated with xanthate. The key to making a successful separation is in securing a thorough regrind of the original concentrates, and best results were obtained when the mill discharge was held at about 75 percent solids. The probable explanation appears to be that it is necessary to break down existing oil films, and by actual cracking or abrasion to expose fresh surfaces of mineral particles to the action of the reagent, in this case cyanide.

Table No. 6 indicates the results obtained by operation of a small pilot plant having a capacity of one ton per hour. Even though the percent of zinc available in the average run of mine ore did not appear to warrant proceeding with the installation of equipment to make such a separation, these results at least indicated what might be accomplished along the lines of further elimination of pyrite from the finished concentrates.

To Mr. O. Wiser, Consulting Metallurgist, for the Howe Sound Co., of which this company is a subsidiary, is due a large measure of credit for improvements which have been made in milling practice at Britannia during the last three years. The present writers also wish to express their appreciation to Mr. C. P. Browning, General Manager, and to other company officials, whose policy has made such advances possible.

STANDARD EQUIPMENT

The Department of Commerce reports that elimination of 762 seldom-used sizes of valves and fittings and 18 sizes of wrought iron and wrought steel pipe and pipe fittings was decided on at a conference of makers, distributors and users of this commodity. New production will become effective September 1, and existing stocks will be reduced to the recommended sizes by January 1, 1927.

Fifty-four concerns, and 10 trade associations have adopted simplified practice recommendations for tin and galvanized household ware.

Accepting simplified practice recommendations on steel reinforcing bars and steel spiral rods, the Alamo Iron Works, of San Antonio, says it has been of great assistance to all interests and has lowered costs. The schedule is adequate for all buildings, and as a result of the simplified practice, costs will be lowered.

COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

NEWELL G. ALFORD, Editor

Practical Operating Problems of the Coal Mining Industry

TIMBER PRESERVATION AT PRIMERO MINES

Methods Used And Results Obtained In Timber Preservation At The Primero Mines Of The Colorado Fuel And Iron Company Where Extremely Bad Roof And Tremendous Side Pressure Makes Timbering Problem Serious

By F. T. BAKER *

THE Primero coal mines of the Colorado Fuel & Iron Co. are located in Las Animas County, Colo., about 17 miles west of Trinidad. The coal is a heavy coking, and of a very friable nature. Height of seam is 6 feet 6 inches.

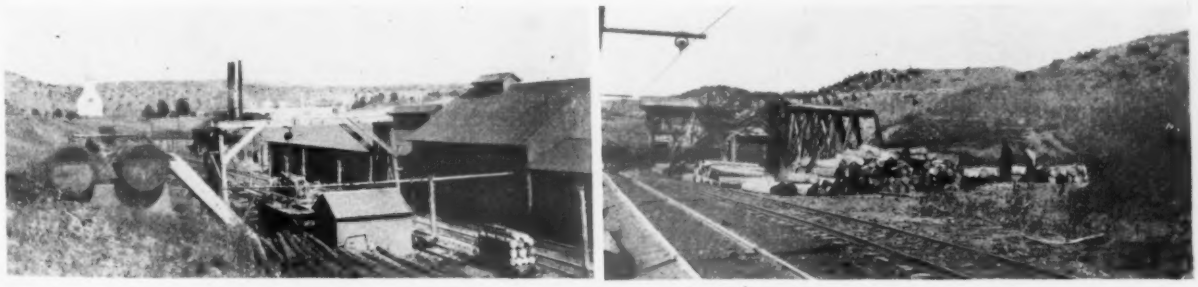
An extremely bad roof, together with tremendous side pressure, necessitates the use of cross bars in both rooms and entries, spaced on 3½ foot centers. Seven and 8-foot props with 5 to 6 inch tops are used in rooms. Rooms 14 feet wide are driven 200 feet on 50-foot centers, and the pillars must be pulled back quickly before the squeeze caused by heavy side pressure comes on. Failure of cross bars is followed by a roof fall varying anywhere from 5 to 15 feet or more in height. Entries are driven 9 feet wide and special peeled piling with an average diameter of 12 inches are used for cross bars. With conditions such as these, it is readily seen that the timber problem is a serious one. Timber sets on return aircourses are affected with a fungus growth shortly after they are set. This causes rapid decay, and they do not last longer than from two to three years, especially where a humid condition exists.

With a view to remedying their timber problem, this company in 1922 installed a timber-treating plant, and the following is a brief description of the arrangement:

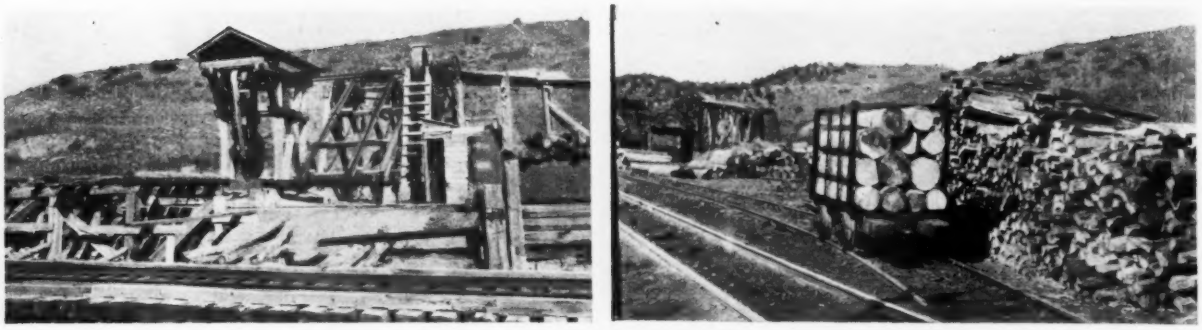
An open tank dipping process, consisting of two open treating tanks, size 22 feet by 4 feet 3 inches; one 20,000-gallon capacity storage tank, size 10 feet 6 inches by 29 feet 5 inches; two storage tanks, size 16 feet by 66 inches, constructed from old boilers, these are for hot and cold storage, capacity 2,800 gallons each; one 12 by 7 by 12 Burnham pump, and one 3-ton Triplex chain block suspended to a traveling crane. The 20,000-gallon storage tank is connected with hot and cold storage tanks by a 3-inch gravity pipe line, and these tanks are connected with treating tanks by 4-inch gravity lines. The return from treating tanks to hot and cold storage tanks is through 4-inch lines, liquid being pumped back with Burnham pump.

For the larger part we have used creosote for the preservative and have been treating native pine and red spruce timber. This timber is cut within a radius of 25 miles from the plant, and the bark is removed and timber allowed to thoroughly season before shipment.

* Superintendent, Primero mines, Colorado Fuel & Iron Co.



Timber treating plant of the Colorado Fuel and Iron Company, Primero, Colorado



Timbering preparation and transportation at Primero

Upon its arrival at the treating plant it is unloaded on a platform for the sawmill and cut to proper lengths. It is then framed according to specifications and loaded on cages placed on pit-car trucks and taken to the treating plant.

The treatment required varies, of course, with the kind of timber and state of seasoning. We have found that red spruce requires a longer period of immersion to secure proper amount of absorption than the native white pine.

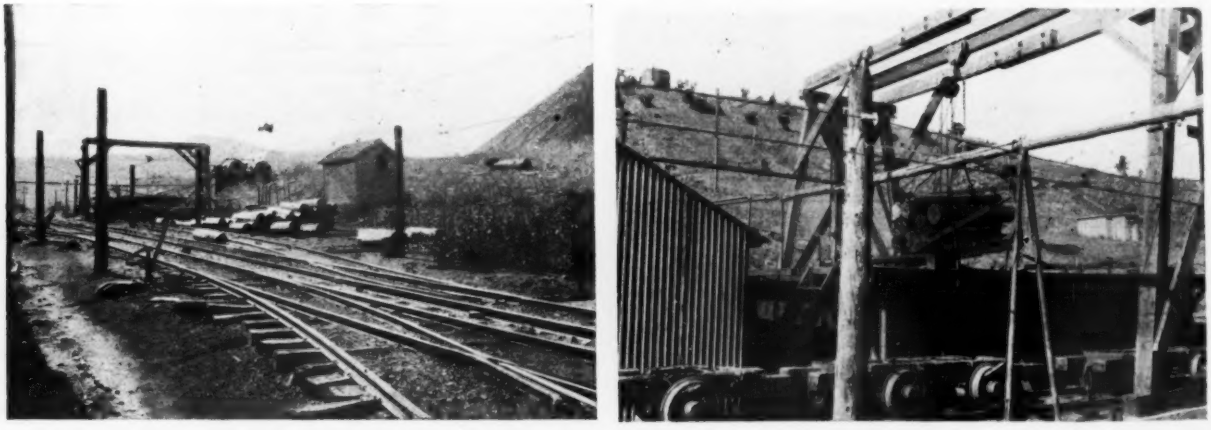
The method of treatment is as follows: The cage with timber is hoisted by means of chain blocks into one of the empty treating tanks. Each cage will hold from 9 to 12 timbers of 14-inch diameter, varying in length from 7 to 10 feet. Each treating tank will hold two cages, or a total of four at one time. After the two cages of timber have been placed in one of the empty tanks, the valve is opened from hot storage tank until cages are submerged. By an arrangement of steam coils in bottom of the treating tank, temperatures are gradually raised to a point from 150 to a maximum of 200 degrees F. Timber is kept in the hot bath from one to two hours, according to seasoning. The second tank is filled with two cages of timber and the valve from the cold storage tank is opened to the first treating tank, causing the hot liquid to overflow in second tank. Timbers are left in cold bath only long enough for the liquid to reach minimum temperature, which will vary from 60 to 100 degrees F. If timbers have received treatment just prior to quitting time we usually keep them in cold bath over night.

As soon as timber is dried thoroughly after being removed from tanks, they are taken into the mine and placed in entries where it is figured that the life of the entry would exceed the life of untreated timber, otherwise there would be no objective gained, as treatment is expensive, and a treated timber will break as readily as an untreated one when a heavy "squeeze" is encountered. Extreme care must be exercised in transporting treated timber into the mine and setting in place, as the value of the treatment is greatly reduced if through any cause the surface of the timber is exposed inside of the penetration of the preservative. It is a good plan to furnish timbermen with a supply of preservative at their working places so that they may give a brush coating to any exposed surfaces.

All treated timbers are dated with nail tie dates showing the month and year in which they were placed in service, and in this manner accurate records are easily available.

The first timber was treated with this process in December, 1922. Native white pine timber was used, and the first of these treated timbers were placed in the First North entries in February, 1923. Untreated timbers were also placed at varying distances along the entry so that we would be able to make comparisons. An inspection in April, 1926, over three years afterward, showed the treated timber in as good condition as when they were placed in these entries, and the untreated timber so badly decayed at the bottom that a 4-inch knife blade could easily be pushed its entire length into them. They are located on a return-air current, and as this section of the mine has not been worked for the past two years, very little circulation of air has been permitted. This condition is equally true throughout the mine where treated timbers have been used. However, there are some cases where fungi has accumulated on timbers treated with creosote, but it is my opinion that this is due to the use of improperly seasoned timber, imperfect treatment, or rough handling in transporting into the mine, and not through a failure of the preservative.

In July, 1922, we placed several sets of timber treated with the preservative, Aczol. The ingredients of this preservative are ammonia, zinc, copper, and phenol, and it is claimed that they are combined in such a manner that they are



Other views of the timber preparation and handling equipment at Primero

completely soluble during the impregnating period, insuring a thorough penetration, and become insoluble and firmly fixed in the wood after the treatment is completed. This preservative was used in a 6 percent solution, 6 parts of the concentrated material was diluted with 94 parts of water to obtain the proper strength for the treating fluid. The only precaution necessary was to pour the concentrated solution into the water of dilution under constant stirring to prevent precipitation of any of the ingredients, and to do the treating in a covered tank to prevent premature evaporation of the ammonia.

The application was made at ordinary temperature and the timber was allowed to soak in the solution for several hours. These sets were placed in the third cross entry, and as this part of the mine has been abandoned, the timbers were recently recovered and placed in the main aircourse. All except three sets were in as good condition as when placed in the mine, and an inspection of the three sets that had failed revealed that the timberman who had placed them had sawed off the bottoms of the posts, because they were too long. Untreated timber placed at the same time was found to be badly decayed and not worth recovering. Timber treated with this preservative presents a flinty surface, and the action of the ingredients appear to bind the wood fiber together in such a manner as to prevent the accumulation of mold and fungus. We are very well satisfied with our experiments with this preservative.

In February, 1922, some sets of timber that had been given a brush coat with hot coal tar were placed in the main aircourse near the fire-boss station. After four years service they are in practically as good condition as when placed in the mine, while untreated timbers placed next to them at the same time are in a bad state of decay. On some other timber that was painted with coal tar after the timber had been set up in the mine, it was found to have failed almost to the same extent as untreated timber. This condition was due to the fact that the entire surface had not been covered.

We have kept records of costs of treatment, but they are not of sufficient accuracy to form a basic figure thus far, for the following reasons:

There have been three changes in labor rates around the mines during the past three years. Prices on preservatives have varied as much as 10 cents per gallon. Also, we have not thus far adopted any definite policy of scheduling operations on the different sizes and classes of timber treated.

Cost of treatment per linear foot of piling 12 inches in diameter has averaged about $.076. In treating mine timbers or ties of smaller diameters, the cost per linear foot, of course, would be much less on account of a greater number of linear feet of material that could be handled in the same length of treatment as required for timbers of larger diameter. Cost per square foot of surface of all classes of material treated has averaged about $.024.

Timber such as our native white pine and sawed ties will absorb a great deal more of the preservative than the red spruce. Well-seasoned timber has a greater absorption than unseasoned.

While we have been more or less in the experimental stage in the use of preservatives, and the treated timbers have not been in service for a sufficient length of time to reveal what length of life we may expect from them, results so far indicate that the use of preservatives will result in a considerable saving in mine timber costs.

CHANGES IN LIST OF PERMISSIBLE EXPLOSIVES

A LIST of additions removals, and changes in the permissible list of explosives during the year 1925 is contained in Serial 2737, recently issued by the Bureau of Mines, Department of Commerce. A complete list of permissible explosives tested prior to January 1, 1925, was published in Bureau of Mines Technical Paper 376.

GEORGIA CLAYS FOR BRICK MAKING

THE Georgia sedimentary kaolins, bauxitic clays, and bauxites tested by the Bureau of Mines show deformation values from cones 34 to 30. Bricks made from them showed superior load-carrying capacity, and good resistance to spalling. The resistance to slag is not very different from a high-grade clay fire brick. Enough work has been done to demonstrate that these refractory materials can be made into brick in a practical way, both by the dry-press and slush-mold processes. Furnace tests under actual working conditions have shown that the service rendered by fire brick made from Georgia sedimentary kaolins was at least equal to and in the majority of cases superior to that of fire clay and silica brick.

Inasmuch as the high-grade accessible fire clays are waning, the average quality of the fire brick decreasing, and the demand for better fire brick increasing, it would appear that the future of the fire-brick industry lies in the utilization of the sedimentary kaolins, bauxitic clays, and bauxites of the coastal plain. Vast areas are underlaid by deposits of such substantial thickness that there is enough high-grade material to meet the needs of the refractory industry for generations to come.

LEGISLATIVE REVIEW

(*Continued from page* 527)

gations which are designed to make the United States independent of foreign sources of potash and to encourage the development of a new American industry.

The bill is designed to determine the location, extent, and mode of occurence of potash deposits in the United States and to conduct laboratory tests as to the quality and use of potash. The Secretaries of Interior and Commerce are authorized to cooperate with individuals, associations, corporations, states, municipalities, educational institutions or other bodies, under formal agreement, in carrying out the purposes of the legislation. Before undertaking drilling operations upon any tract of land the Secretaries of Interior and Commerce jointly shall enter into contract with the owners or lessees of the mineral rights, the contract to provide that not more than the actual costs of the exploration shall constitute a preferred claim in favor of the United States and its cooperators against any minerals developed; the contract shall provide that the owners or lessees of the lands and mineral rights within a mile of a proposed well shall pay the Government and its cooperators an amount equal to the actual costs of said explorations, payments to be made at such time, in such manner, and in such proportions as the departmental Secretaries may determine equitable. The contract shall not restrict the Secretaries jointly in the choice of drilling locations within the property or in the conduct of the exploratory operations, so long as such selections or conduct do not interfere unreasonably with the use of the surface of the land or its improvements. The contract shall provide that the United States and its cooperators shall not be liable for damages on account of reasonable use of the surface necessary in the proper conduct of the work. Before drilling is commenced the Secretaries, jointly, shall require the owners of lands and mineral rights within a radius of not less than 1 mile of any proposed well, in consideration of the probable increase in value of such lands and mineral rights incident to discovery of potash, and in order to prevent profiteering, to enter into agreement whereby the Secretaries jointly are empowered to act as referees in determining the maximum price at which the potash rights in such lands can be sold. This agreement shall run with the lands and mineral rights. The owners of potash rights, in consideration of the advantage accruing from an equitable price for such potash rights as effected by the Secretaries, may be required to enter into an agreement whereby the potash produced from the lands shall be marketed at a price not in excess of a maximum determined by the Secretaries jointly as equitable.

PRESERVATIVE TREATMENT OF MINE TIMBER

The Mining Industry Has Been Slow In Development Of Treated Ties And Timber Principally Because Forest Products Were Cheap—Today The Modern Mine, To Be Operated Economically, Should Treat All Permanent Or Semi-Permanent Ties And Timbers With A Standard Preservative

By GRANT B. SHIPLEY*

THE railroads in this country are to be congratulated on what they have accomplished during the last 20 years by treating their ties and timbers. When such railroads as the Santa Fe, the Pennsylvania, the New York Central and others can show treated ties which have been in the track over 20 years but which would ordinarily have decayed in from three to eight years, there is no further doubt as to the economy of using treated material and the mines can get similar results. Some mining engineers have hoped that substitutes would eventually eliminate the use of wood ties and wood timbers in mines and, therefore, the treating problem has been neglected by them.

* Engineer, Century Bldg., Pittsburgh, Pa.

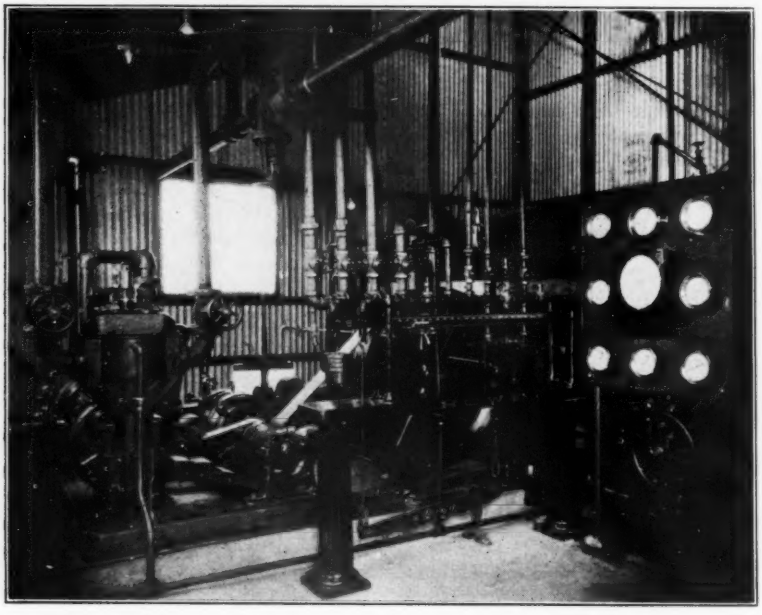


Fig. 1.—Interior of a very complete small outfit

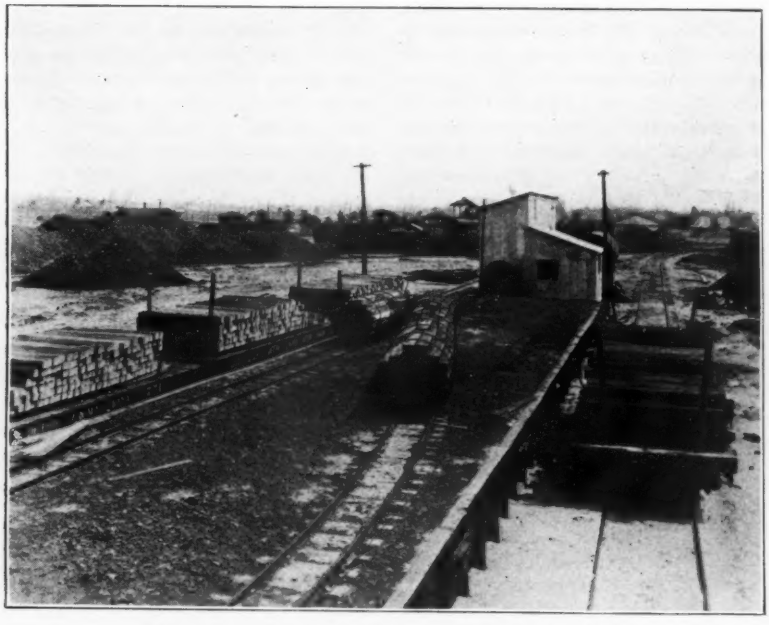


Fig. 2.—Loading platform and treating building

Concrete, steel and gunite each has its place in mines, but it is a fact that the treated wood is more flexible and more economical when installed in its proper place. It is generally understood that the average life of untreated ties and timbers in the mines is three years and, when this same material is properly treated with a good preservative, there are possibilities of increasing this life to anywhere from 9 to 25 years or even more. The railroad experience has demonstrated that coal tar creosote and zinc chloride as preservatives are satisfactory; that there is no question about getting results with these standard preservatives. Some mines may condemn the use of creosote on account of the fire hazard but, if the wood is thoroughly treated and made free of drippage after treatment, the risk is not great, especially in wet mines. Zinc chloride is sometimes condemned for fear the zinc will leach out; however, tests have demonstrated that, when wood is thoroughly treated with a zinc chloride solution, the leaching does not prevent a great increase in the life of the timber. Other preservatives have been used to a limited extent in this country and are being advocated.

To secure thorough penetration and treatment of the wood, all treatment should be done in a closed treating cyl-

Fig. 3.—Tram car loaded with mine ties

inder under pressures of from 150 lbs. to 250 lbs. per square inch, depending upon the species of wood. Painting and open tank treatments are helpful but not thorough and the labor for such work is nearly the same as on pressure treated material; furthermore, in the creosote treatment more expensive oil must be used in painting or in the open tank treatment in order to decrease drippage and I believe this is one of the reasons some mines consider creosote a fire hazard. The pressure process should be used wherever possible in preference to any other treatment and if used in accordance with either the American Wood Preservers' Association or American Railway Engineering Association standard specifications will get results. These specifications are the product of the best railroad engineering practice in the world today; which experience the mines should capitalize to avoid unnecessary experimentation.

Pressure processes are operated by either the full cell or empty cell system. The full cell system is based on filling the wood cells with preservative, or nearly so, and is used in all salt treatments or if heavy creosote treatments are required. The empty cell system is based on pumping into the wood cells a large amount of preservative, then extracting part of the preservative, leaving the cell walls or fibres coated and thus reducing the net consumption of the preservative. The empty cell treatment is operated by two methods, which are the Rueping process and the Lowry process. In the Rueping process, initial air pressure and a final vacuum are used. With the Rueping process it is possible to get deeper and better penetration in all woods with less preservative, for the initial air opens passages, thus permitting deep percolation of the oil and, by regulating the initial air pressure and oil pressure to suit the species of wood, the required final retention can be controlled whereas, with the Lowry process, having a final vacuum only the retention cannot be so completely controlled; and more preservative is required to get a deep penetration. To get good penetration and thorough treatment, all wood should be free of bark and nearly dry. The most economical way to dry mine ties and timbers is to carefully pile in the open where the air can circulate around the material and let it air-season. Pine can be steamed and part of the moisture extracted under a vacuum. Green fir, oak and hardwood can be boiled in oil under vacuum to reduce the water content.

To further aid penetration, the refractory woods like fir, tamarack, hemlock, etc., can be run through an incising machine, which punches small holes in the wood surface. All timbers for construction work should be framed before treatment and all ties should be adzed and bored before treatment.

During the last few years the new railroad and commercial treating plants have made a great many improvements in design and operation and, where each plant is treating anywhere from twenty million to eighty million board feet, they have found that any improvement which will give better treatment and save a fraction of a cent per cubic foot is

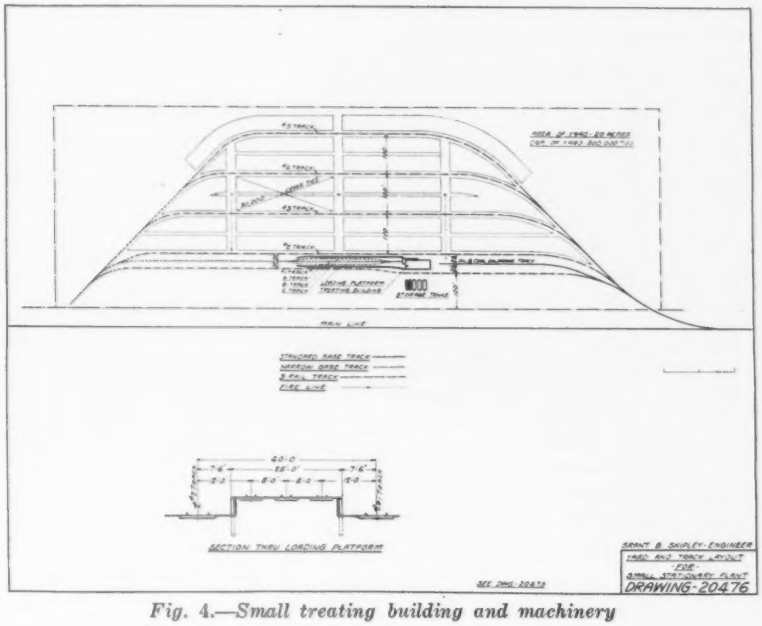


Fig. 4.—Small treating building and machinery

Tram car loaded with mine ties

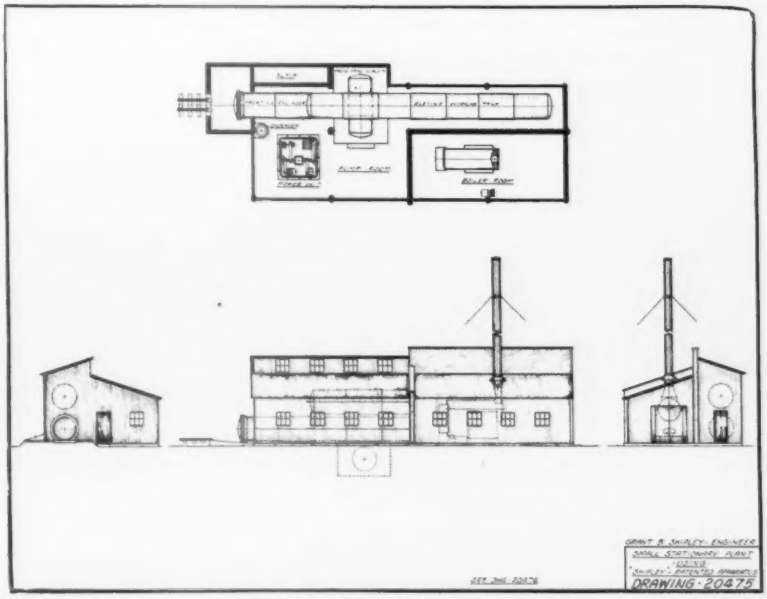


Fig. 5, Yard layout for small plant

worth while. Nearly all of these new plants are constructed to use any preservative with the Rueping process as well as any other process; they are using higher pressures with tank scale weighing devices, high pressure air storage with motor driven power units where possible. The mines can profit from this experience but the treating plants for mines must, of course, have smaller capacities.

The ideal location for a small treating plant is near a power plant where steam for heating the preservatives, either low pressure or high pressure air, water and electric current for driving the motor operated power units are available. Furthermore, with such a location it is nearly always possible to operate the plant under the supervision of a regular foreman and use convenient common labor, thus keeping down the cost of operating. Where a mine can have material treated in transit, it is often more economical to have the work done by commercial treating plants which make a specialty of such work.

The size of a treating plant will depend on the species of wood to be treated, the quantity and size of the material to be treated per day of 24 hours, the preservative and process to be used and the seasoned condition of the wood. The treating cylinders are made from 36-in. diameter up to 96-in. diameter. For small mine treating plants cylinders either 63-in. diameter with 24-in. gauge track or 74-in. diameter with 30-in. gauge track are the most practicable and these cylinders should be designed for not less than 200-lbs. working pressure.

Today there is only one argument in favor of using untreated mine timbers; that it does not pay to treat posts or cribbing that cannot be recovered. All other ties and timbers around a mine should, without question, be thoroughly treated with a good preservative under a good stiff pressure even where timber is covered with a coat of cement or gunite. It should first be treated because this covering will not stop the incipient dry rot or decay which will in time weaken the timber necessitating early renewal. Steel mine ties or steel mine timbers are good in their place, as for portable track in rooms but for main haulage roads and where there is acid water, look out for corrosion and short circuits. Reinforced concrete for permanent shafts, collars and heavy pillars is good construction, but it is hard to beat the cost, the life and flexibility of good timbers thoroughly treated under pressure.

If only the bituminous coal mining industry and some other mines had started the use of treated ties and timbers several years ago in the mines it has been necessary to close down for months and years just think of the enormous saving which would have been apparent upon opening up these mines. Had thoroughly treated material been used instead of requiring almost complete re-timbering the mine would have been almost intact and ready for the resumption of production. Considerable has been written and published regarding the economy of using treated mine ties and timbers and there is some reliable data available on the subject but more convincing than this are the timber preserving experience of some of our trunk line railroads. Some of these roads have reduced their cross tie requirements in round numbers from 300 ties per mile to less than 100 ties per mile and expect to do better. See Figure 6 showing Santa Fe tie renewals by years. It is apparent the mines can and will get just as good results.

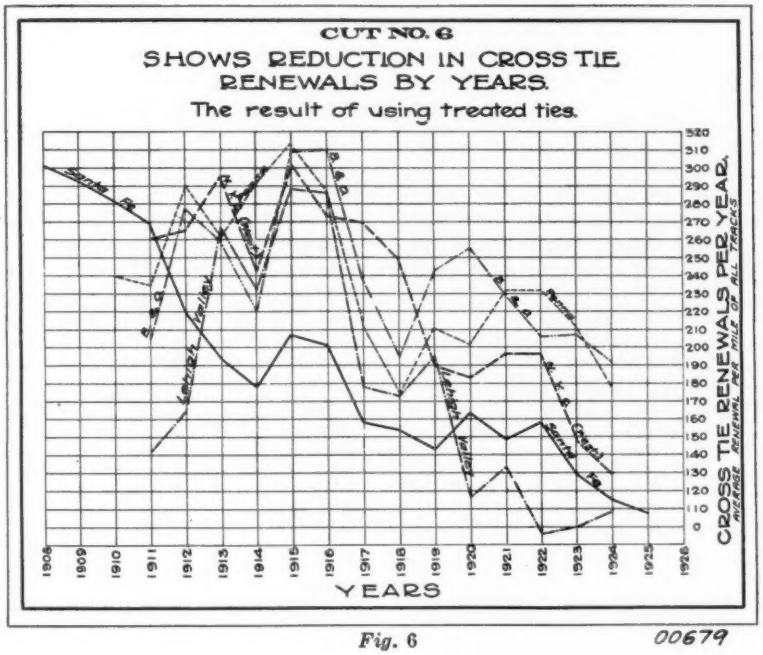


Fig. 6 00679

We should not stop thinking when someone quotes the first cost of the untreated tie or the first cost of the treated tie. A similar condition applies to timbers for good mine timber is getting scarce and is increasing in cost. When a big mine tie is taken out, due to rot, it costs about $0.54 per tie to take it out, replace with another, spike and ballast; besides such work interferes with haulage. When a mine full of untreated timber is closed down for any length of time, the maintenance must be kept up or the mine will be nearly ruined. Treated timber will save most all this expense and trouble.

The substantial mines with their large investment in outside tipples and equipment are finding it necessary to cover greater mining areas; therefore, longer hauls are requiring heavy rails, larger ties and big mine locomotives for hauling more tonnage at high speed, demand a better road bed and the only way to get this is by using treated ties.

When concrete is put into a mine, we must be sure that the design is good and finished for all time since alterations are most expensive but if treated wood is used, changes can be quickly made at a low expense. When steel mine ties or steel timbers are put into a mine, we must be sure they are scraped and painted often; otherwise the rust and acid will decrease their strength very rapidly. It is a shame to put a good big untreated wood post, wood cap or timber into a mine and let it rot out in a few months or a few years when such superior results would be obtained from treated timber; furthermore, it is dangerous to depend on the strength of untreated timber. As an instance of this take a 6-in. diameter post, put it in to carry a load to suit, let one inch of this sapwood decay and the strength has decreased just 30 percent. If the mine engineer knows that full strength will be retained by treated timber, he can design more closely on the original installation.

Large quantities of posts are lost in a mine but if the mine foreman were using treated posts and knew their durability, more posts would be salvaged.

Just look at a piece of cut over timber land after the mine ties and pit props have been taken off. There is nothing so desolate and, from a fire standpoint, nothing so dangerous. The

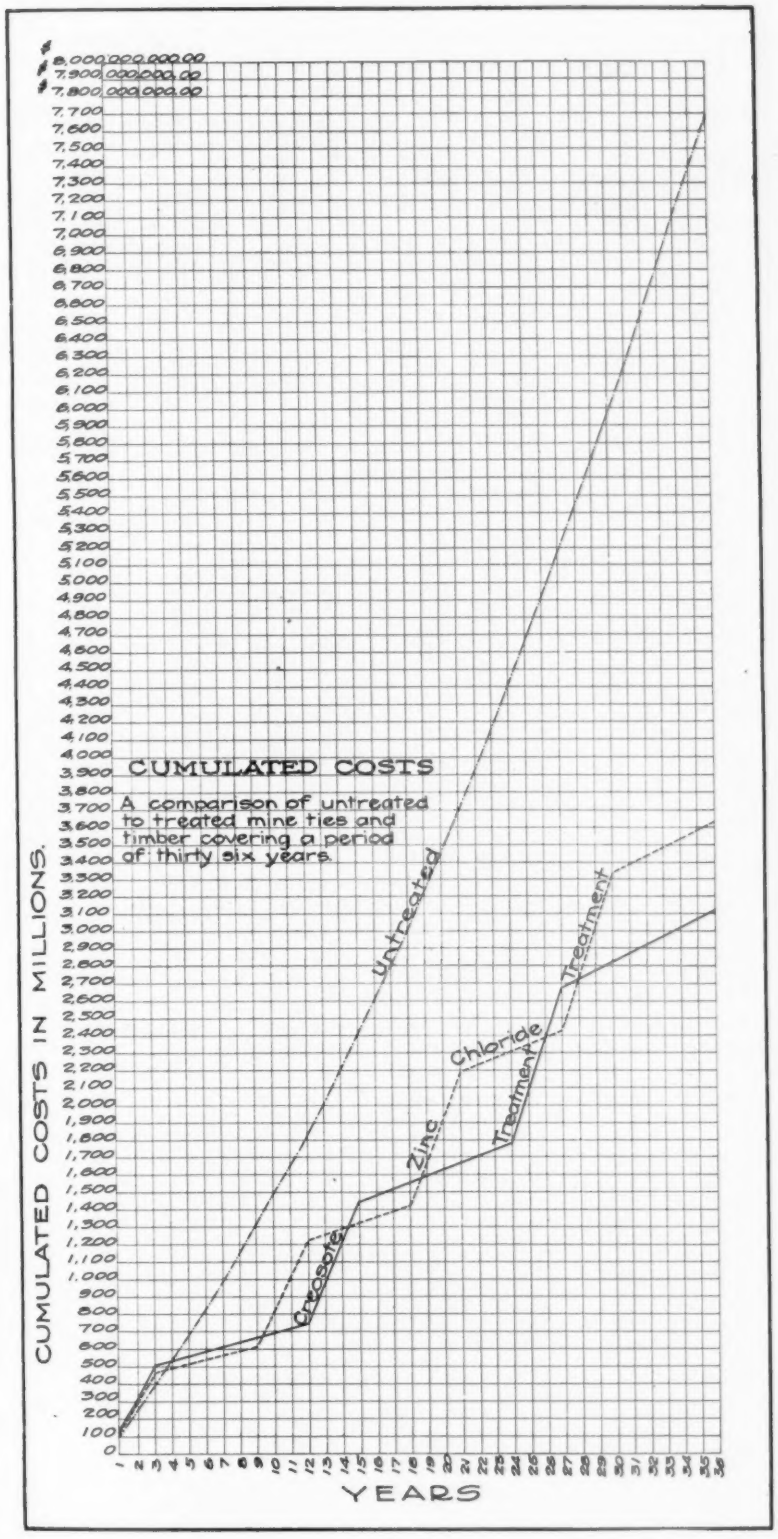


Fig. 7

forest and land is a wreck and looks like a battlefield. It has always seemed to me that the fellows who cut this timber held a grudge against nature, for many young trees which will not produce anything are ruined, the land is a mass of brush left from the trees which have been cut down, leaving a fire menace and it is almost impossible to keep fires out of such wreckage.

Where possible all timbers should be air-seasoned before treatment but where this is not possible, timbers can be seasoned by steaming or by boiling but with an additional cost. Seasoned material can be treated in an average time of five hours, whereas steaming or boiling will run from 12 to 48 hours. All untreated mine timbers around coal mines may be compared to white oak as having 100 percent resistance to decay or relative durability whereas other untreated species of nearly the same strength, like beech, birch, maple, the red oak group, etc., are only rated at 50 percent.

Treatment will increase the resistance of any of these woods to 300 percent or better and make them just as valuable as white oak. By making a greater variety of woods available for mine use, consistent treatment will reduce the cost of timbers and conserve forest resources.

For a comparative basis the cost of an untreated 6 in. by 6 in. by 5 ft. 6 in. mine tie may be taken at 40 cents. To this should be added the cost of taking out one old tie and placing a new tie in the track at a cost of 54 cents. This gives a total cost of one untreated tie installed in the track at 94 cents, whereas the cost of a tie treated with zinc chloride is $1.085, and the cost of a tie treated with creosote is $1.18. Assuming that the life of an untreated tie is 3 years, a zinc treated tie 9 years and a creosote treated tie is 12 years, the average annual renewal costs over a period of 36 years will be as follows:

AVERAGE ANNUAL RENEWAL COSTS

	Per tie	Per cu. ft.
Untreated	$0.643469	$0.467977
Zinc treated	0.291561	0.212044
Creosote treated	0.255252	0.185638

Statistics show where treated material has been in the mines for over 18 years; therefore, the above figures are more than conservative. There is approximately 900,000,000 cubic feet of timber in the mines in this country. Since the average life of untreated timber is only three years there is required 300,000,000 cubic feet of untreated timber each year. There are possibilities for treating 55 percent of this amount in order to prevent its destruction by decay or insects; therefore, 165,000,000 cubic feet per year could be treated at a tremendous saving. Spreading the use of timber over a 36-year period the untreated timber must be replaced 12 times, the zinc treated timber must be replaced 4 times and the creosoted timber must be replaced 3 times.

Figure 7, showing the accumulated costs, will give a good idea of the comparative costs (*Continued on page* 550)

THE NATION'S VIEWPOINT

A Digest Of The Expressed Opinions Of Leaders In American Affairs

SECRETARY of Commerce **Herbert Hoover** appeared before the House Committee on Interstate and Foreign Commerce, in its hearings on proposed coal legislation, a part of his testimony being as follows:

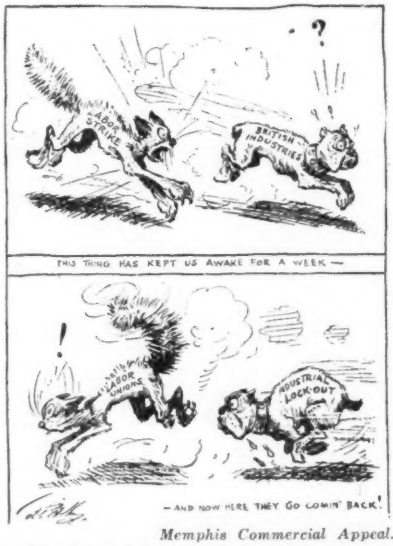
"If we are to have periodic strikes or lockouts, with their accompanying coal famines and profiteering, the public does need protection on these occasions. I do not believe that anything in the nature of compulsory arbitration is a remedy for failure of industrial relations. No one can compel either employe or employer. The only thing that we have so far discovered that helps in such situations is mediation by some outside agency, and most coal suspensions have been brought to an end sooner or later by such mediation. Every single bituminous dispute of importance in recent years has ultimately been thrust up to the President for some action. It is impossible for the President himself to successfully carry on such negotiations. He must delegate action to somebody. The national coal commission recommended and the President has asked that he should be given authority to appoint a mediation board in such emergencies as are likely to bring about nation-wide suffering.

"I believe it desirable that such a mediation board should not be permanent but of emergency order, as it is best to bring new minds and new men on the scene of such emergencies. In order that it may function promptly and effectively it must be armed with the basic economic facts as to the industry. They can not be collected in emergency—there should therefore be continuous collection and publication of fundamental statistics upon production, distribution, stocks, consumption, wages, and average prices. If the industry could furnish these facts regularly and reliably of its own volition, it would be better that it do so than to put the Government to the expense.

"If the mediation board fails to secure solution, and the suspension is widespread enough, then the emergency of famine inevitably follows. In most of our great bituminous suspensions hitherto supplies have degenerated to the point where public utilities and other essential services have become endangered. There has always been a considerable portion of non-union production of bituminous coal. Out of this production the public services of the country can be protected by a careful distribution of the supplies available. Therefore it seems to me that it is desirable to arm the Government through the Interstate Commerce Commission with power to control distribution during such emergencies.

"Thus it seems to me there are three things to be considered by the committee at the present time: An emergency mediation board, an emergency authority to the Interstate Commerce Commission in coal distribution, and in failure of provision by the industry a more effective service as to primary facts. This is not regulatory legislation, and would come into action only in failure to maintain production.

"Such measures as are here discussed, of course, simply deal with symptoms of much more deep-seated diseases. A much wider and deeper question is the cause of the unhealthy economic condition of the bituminous industry which results in these periodic difficulties. Diagnosis of these diseases is easy enough. It has been performed a score of times, but the remedy is by no means plain, and certainly there is no agreement on the part of any two important bodies in the country as to solution.



Memphis Commercial Appeal.

It's Just One Thing After Another

"A short summary of the fundamental ills of the bituminous industry will show that they center around two main causes—too many mines and the seasonal character of the industry.

"1. There are about 9,000 different mines in about 90 different districts, probably 5,000 operators having a total production capacity of 900,000,000 annual tons, against a maximum requirement of a rate of 600,000,000 tons annually. There are about 620,000 men employed in the industry, which is about 200,000 more than would be necessary if the required portion of the mines were employed to their utmost capacity. The overexpansion is the result of many causes into which all the following enter:

"(a) War stimulation.

"(b) Economies in use of coal through more efficient use under boilers; through more economical metallurgical processes; through electrification; through by-product coke, oil, etc.

"(c) Increasing capacity of non-union fields due to the lower wage range always maintained there, thus tending to duplicate equipment in the union fields.

"(d) Great profits during famines arising from strikes, lockouts, and car shortages, which induce people to enter or remain in the industry in hopes of such recurrent profitable periods.

"(e) The effect of the Sherman Act in preventing the organization of larger units of production and distribution which would in effect retire the less economic mines to reserves and thus more regular operation to the more economic mines.

"(f) Periodic car shortages (less important than formerly).

Wallace Press-Times

Fun Temporarily Postponed

Wallace Press-Times

Lotta Pep

Wallace Press-Times

Our Senator Has a New Nag

"2. The industry is to some degree seasonal in demand and therefore in production.

"The net result of all this is that we have part-time operation of too many mines and the final consequence that most workers, especially in the commercial mines, are only employed part time, and while the daily wage is usually very high it does not for some fraction of their number constitute even a decent annual living. The bituminous industry is in long view a losing business in the periods between famines, and no unprofitable industry can give satisfaction either to consumer, worker, or operator. From all these causes arise most of our labor friction."

That the protective tariff is a sound business proposition, and so looked upon by the country irrespective of political parties, is the contention of the **Hon. Frederick H. Gillett**, *Senator from Massachusetts*, who in a recent speech said:

"The tariff argument has changed very much. Originally it was a tax, a protection to manufacturers. Then it was called an infant-industry proposition, and I presume it was thought originally that the tariff was only necessary until they were on their feet and then they would be able to protect themselves against the world. In those days, of course, a tariff on agricultural products was not thought of, because our virgin fields could beat the world. But gradually, gradually, the tariff became an implement to make the United States self-supporting and independent, and the view was taken not that it should be simply a temporary expedient but that it should be a permanent policy to protect every industry of production in the United States that could not fairly compete with similar producers in other countries; and so it has become a permanent institution.

"Of course, under it many of our protected industries have grown so that they do not need protection. We have seen industries here—sometimes by the skill of the mechanics, sometimes by the ingenious machinery that was invented, sometimes by the genius for organization which the head of an industry developed — outstrip their competitors in other nations, so that the tariff was quite unnecessary and superfluous. But, as a rule, our standard of living, our pay to our laborers in the case of most of our production, whether agricultural or industrial, requires a tariff, because long since our virgin fields of the West have found competitors which could outstrip them or underbid them in the markets of the world. Therefore we gradually required a tariff to protect them as well as to protect our industries."

The Boston Herald is of the opinion that no coal legislation at this session of Congress should be enacted. In a recent editorial they say:

"Our idea is that Congress would do well to adjourn without passing any coal legislation. Any business which is open to so wide competition as coal mining will take care of itself, just as does the textile manufacturer and countless others. When governments get into the game, as the British Government did with the coal industry in Great Britain, the long-distance results are unhappy. If we have legislation giving the President authority to act in an 'emergency,' who is to judge when that arises? We might have a socialistic President who would see an emergency, for political or other purposes, long in advance of its arising. We have had a coal strike. It led to undoubted inconvenience, but to no real suffering. Had the Government been a partner in the enterprise we should, as American consumers, be far less happily situated than we are today. Let economic law work its way out. Let individual enterprise rather than bureaucratic oversight determine our industrial future with coal as with other things."

James S. Douglas, *United Verde Copper Co.*, takes issue with Senator Cameron in his advocacy of a tariff on copper, saying:

"There are many arguments against the proposed copper tariff and none for it. Leaders of the copper industry are not in favor of the tariff but consider it would be a detriment to the industry.

"The copper industry is managed by experienced business men who are better able than any meddling politicians to know the needs of that industry and consequently any demand for a tariff on copper should come from the leaders of the industry and not from politicians.

"There has been a slump in the copper industry which leaders of that industry know well how to handle in a business-like manner. The proper remedy for the slump is not a tariff but the creation of a new market for copper products and new uses for the metal itself.

"The exactment of a 6-cent tariff as proposed for the country would involve foreign nations to retaliate with a like measure which would be harmful to American industry.

"The tariff which was placed on imported wheat has been harmful to the very industry which it pretended to protect, and the copper tariff would have the same effect on the copper industry which it would be supposed to aid."

The growing necessity for timber conservation was the burden of a speech by the **Hon. John Morrow**, *Representative from New Mexico*, on the floor of the House. Mr. Morrow gave some interest-

ing figures concerning timber in his state, saying:

"It is given out that New Mexico and Arizona have the largest area of unbroken yellow pine left in the nation, there being in one continuous area of these two states 4,000,000 acres. The national forests of New Mexico and Arizona comprise 23,500,000 acres and contain 23,000,000,000 feet of timber, the amount being about equally divided between the two states. There are also vast timber areas in the Indian reservations.

"The passenger traveling by railroad through the states of New Mexico and Arizona carries the thought that the states are barren of timber. For his information let me add that the forest reserves and Indian lands together contain 35,000,000 acres of timber land. They contain 37,000,000,000 feet of saw timber and 63,000,000 cords of wood. These estimates only apply to Government reserves of timber. These states also possess much timber privately owned upon land still belonging to the Government.

"It is stated that there is cut each year in Arizona and New Mexico over 34,000 acres. But the timber cut under forest supervision is so cut as to reforest itself, and the timber is not denuded and destroyed; it is so cut that it will regrow a new crop in the shortest time possible.

"During the time of regrowing the new crop there remains a sufficient crop of young timber to protect the watershed. The 1924 timber cut in the two states was 142,000,000 board feet in Arizona and 126,000,000 board feet in New Mexico. The latest United States census figures estimate that 400,000,000 board feet of timber were used in these two states during the past year."

A speaker at the Cincinnati meeting of the American Mining Congress said that the "selling end of the coal business lacks brains," and *The Virginian*, Fairmont, W. Va., takes decided issue with him. They say:

"If an outsider had said the selling end of the coal business lacks brains it would have made most coal men mad, but when one of their own number says it on the floor of the American Mining Congress they will have to stand for it. And yet it is not altogether true.

"There is quite as much brains in the coal trade as there is in most other businesses. The great lack is organized information and mutual confidence. Either probably would put a stop to the buyers 'getting away with murder,' to quote another remark made at Cincinnati this week, but both together would just about put the coal industry back on its feet.

Washington Post

Bear in Mind, You're Both Under the Same Umbrella

"Of course, there is nothing new about this. It has been admitted in the coal world for years, but for some obscure reason it is impossible to get the industry to adopt modern ideas and to get around to the point where business can be done as it is done in other lines.

"There probably is as much potential over-development in the steel industry as there is in coal. The same Sherman law which looms so large in the minds of coal men also governs the transactions of the steel trade, and yet steel is stabilized, and while the margin of profit is far from satisfactory no one is in danger of going to the wall who really understands how to run a mill. As a matter of fact, last year one of the big independent concerns, which had been badly managed through mistakes in judgment of one man, and was in danger of going on the rocks, was reorganized, refinanced, and put on its feet as a going concern without any particular flurry in the trade.

"That performance would not have been possible had there not been general knowledge of the whole steel situation and an abundance of confidence among the men in the industry which makes it possible to make informal agreements that stick. If the same system could be transferred to the coal industry it would be possible to get more for coal at the mine, because it would put an end to the activities of purchasing agents who play off one operator against another and take advantage of the necessities of operators who are staggering along under a load of unwisely made royalty contracts."

Another statement made at the Cincinnati meeting, that the use of water power is decreasing the demand for coal, has caused wide editorial comment. From the Passaic, N. J., *News*, we print the following editorial:

"There is no mystery about the difficulty the coal industry is having in England and America. It is simply a big industry, highly capitalized and highly manned, whose market is failing it.

"Strangely enough, the tremendous increase in industrial activity is requiring less coal rather than more. The American Mining Congress finds that the increasing use of water power and oil has deprived the coal industry of a market it would otherwise have for 100,000,000 tons of coal a year.

"The amount of water power substituted for fuel is going to increase steadily. The use of petroleum for fuel, now growing rapidly, may wane with the exhaustion of oil deposits, but there is no telling when that will come.

"There is, however, an obvious remedy for coal troubles. American power interests have found that they can produce electrical power cheaper by establishing their power plants at the mouth of coal mines, and burning the coal on the spot, than they can produce it from any but the most advantageous water-power sites. England, if industrial statesmanship were applied to the coal industry, would probably do this on a vast scale.

"There would be no great difficulty, from an engineering standpoint, in producing enormous electrical power at the British mines, distributing that power by wires throughout the British Isles, supplying all the energy needed in manufacturing centers and electrifying the whole country.

"That would save the British coal industry and might bring in a new era of industrial prosperity for Great Britain. But unfortunately such matters are determined by political considerations, not engineering wisdom."

A meeting of some 300 mine operators of the Mother Lode culminated in the organization of a Mother Lode Section, which will be devoted to the upbuilding of the mining industry in that district. The Oakland, Calif., *Tribune* has the following to say in regard to the importance of this movement:

"That success will come to the mining men of the Mother Lode in their proposal to form a section of the American Mining Congress goes without saying. Five hundred have already indicated their intention of backing the project and will be pres-

Wallace Press-Times

Way Down East

ent at a meeting to be held in Sacramento, Saturday. Of that number 400 are now members of the Mining Congress and, at their request, a thousand additional invitations have been sent out.

"The Mother Lode Section of the American Mining Congress will be unique. Into that great organization which considers not only gold mining but coal mining and all the other branches, will be established a group of men who are building modern success upon the tradition and achievement of the famous days of old.

"California is the leading gold state because of the enterprise and enduring confidence of the men of the Mother Lode and Sierra-Nevada fields who are constantly uncovering new veins and pushing farther that work which was started in the days of primitive machinery.

"At the meeting this week it is announced that prospectors, miners, engineers, operatives in whatever capacity will be welcomed with management, owners, and investors as a 'family of mutual interests.' The hospitality of the mountain country, the spirit that will bring new triumphs for the Mother Lode, is thus evidenced in the call to meeting."

The passage of the potash bill gives assurance of an intelligent investigation of our potential resources of this valuable mineral. The El Paso, Tex., *Times* makes the following interesting comment:

"The finance committee of the board of regents of the university met in Houston the other day to consider the matter of investing the $3,500,000 which its oil royalties have brought to that institution, but it gave some incidental consideration to the prospective passage of Senator Sheppard's bill looking to the development of a supply of potash in this country. The university has a double interest in that measure. The fact that there are potash deposits in Texas is mostly the discovery of the university's bureau of economic geology, and pretty nearly all that is known as to the extent of them is the product of its investigations. It must seem likely that if the explorations provided for by the Sheppard bill should be made, the bureau of economic geology would have a large part in so much of the work as would be done in Texas. But the university has a larger concern in the fate of that measure because of the possibility, not to say the probability, that potash deposits susceptible to commercial exploitation will be found underneath lands that are a part of its endowment. The prospect of having its oil revenues augmented by potash revenues may well command some consideration from the finance committee of the board of regents.

"The promise, or, to state it perhaps better, the prediction that potash deposits worthy of exploitation would be discovered in Texas has not excited much interest among the people of the state, though probably as much as did the promise made by the first oil well drilled inside Texas. That the prospect warrants more interest than has been manifested is suggested by the fact that the subject was discussed rather fully during the recent meeting of the American Mining Congress in Cincinnati. One of the mining engineers attending made a statement with respect to it which should make the people of Texas sit up and take notice of a prospect toward which they have seemed indifferent."

The Biwabik, Minn., *Times*, among a large number of other newspapers, pays THE MINING CONGRESS JOURNAL a compliment through reprinting in full its recent editorial on "Our Diminishing Timber Resources," saying:

"Who is right?

"There have been recent statements that America has a full timber supply, that forest fires destroy but a tiny percentage of the trees, and that the forests will never be exhausted to the point of a 'timber famine.'

"On the other hand, THE AMERICAN MINING CONGRESS JOURNAL says:

"'The nation is at last awake to the necessity for intelligent action, if we are not to be a country devoid of timber resources,'" and reprints in full the editorial which appeared in the May issue.

Wallace Press-Times

The Flirt

Kansas City Daily Drovers Telegram

Trying to Make It Look Like the Picture

The recent statement by a prominent mining man that the coal industry could very well dispense with a large number of its workmen to agriculture has caused the widest editorial comment. The following appeared in the Berkeley, Calif., *Gazette*, and similar editorials have appeared in most of the leading newspapers of the country:

"A speaker at the American Mining Congress urges idle coal miners in this country to go into agriculture. 'They could produce food as well as coal,' he says, 'and reduce living costs for themselves and the public.'

"Of course, they could. Only half our coal mines are being operated. Only half our coal miners are needed. Half of them might do so during the idle mining periods. But they don't. For some reason or other, the typical coal miner doesn't seem to care for any kind of work except digging coal. The sun and air doesn't seem to appeal to him as they should.

"Farming itself is a part-time job, Henry Ford says. He proposes to alternate farming and factory work. He might try factory work for the miners, who need some side line more than the farmers do. That could be done at the mines, and might suit the miners better."

THE IRON INDUSTRY IN 1925

Considerably More Iron Ore, Pig Iron, And Ferroalloys Were Produced And Shipped In The United States In 1925 Than In 1924, According To Figures Compiled In the Bureau of Mines, And Just Made Public

THE iron ore mined in 1925 amounted to 61,907,997 gross tons, an increase of 14 percent as compared with 1924. The shipments of iron ore in 1925 amounted to 63,924,763 gross tons, valued at $161,796,886, an increase in quantity of 23 percent and in value of 6 percent as compared with 1924. The average value per ton of iron ore at the mines in 1925 was $2.52, which is 39 cents less than in 1924. The stocks of iron ore at the mines at the end of 1925 amounted to 10,795,630 gross tons, compared with 12,410,619 tons at the end of 1924, a decrease of 13 percent.

Pig Iron

The shipments of pig iron from blast furnaces in 1925, amounting to 36,814,703 gross tons, valued at $739,316,333, showed an increase of 19 percent in quantity and 11 percent in total value. The general average value of pig iron of all grades at the furnaces in 1925 was $20.08, a decrease of $1.33 from the value in 1924.

The production of pig iron in 1925, exclusive of ferroalloys, was 36,124,678 gross tons, compared with 30,869,199 tons in 1924. In the production of pig iron in 1925 there were used 62,029,734 gross tons of domestic iron ore and manganiferous iron ore; 2,337,767 tons of foreign iron ore and manganiferous iron ore; and 5,137,068 tons of cinder, scale, and scrap, a total of 69,504,569 tons. An average of 1.924 gross tons of metalligerous materials was consumed per ton of pig iron made in 1925, as compared with 1.896 tons in 1924.

Ferroalloys

An increase of 24 percent in the shipments of ferroalloys from furnaces is shown for 1925. The shipments of ferromanganese in 1925 increased 9 percent and those of spiegeleisen increased 26 percent. The average values per ton reported for ferromanganese and spiegeleisen at the furnaces in 1925 were, respectively, $102.39 and $25.10.

The production of ferromanganese in 1925 was 259,780 gross tons, averaging 78.93 percent of manganese, and containing 205,046 tons of manganese (metal). In the production of ferromanganese in 1925 there were used 519,139 gross tons of foreign manganese ore, 34,942 tons of domestic manganese ore, 4,949 tons of iron ore, and 11,072 tons of cinder, scale, and scrap. The quantity of manganese ore used per ton of ferromanganese made in 1925 was 2.133

IRON ORE MINED IN THE UNITED STATES, 1924-1925, IN GROSS TONS (EXCLUSIVE OF ORE CONTAINING 5 PERCENT OR MORE OF MANGANESE)

State	1924	1925	Pct. of increase or decrease, 1925
Alabama	6,993,613	7,093,250	+ 1
California	435	352	— 19
Colorado	4,702	8,642	+ 84
Georgia	113,039	78,835	— 30
Michigan	12,350,755	14,490,529	+ 17
Minnesota	31,902,085	36,856,244	+ 16
Missouri	79,847	40,043	— 50
Montana	3,913	3,672	— 6
New Jersey	65,197	202,942	+211
New Mexico	189,371	172,959	— 9
New York	255,832	141,534	— 45
North Carolina	12,525	22,011	+ 76
Ohio	244	2,410	+888
Pennsylvania	807,208	955,955	+ 18
Tennessee	179,853	164,717	— 8
Utah	164,154	270,029	+ 64
Virginia	89,792	96,272	+ 7
Washington	1,700	830	— 51
Wisconsin	690,058	817,149	+ 18
Wyoming	363,096	489,622	+ 35
	54,267,419	61,907,997	+ 14

IRON ORE MINED IN THE UNITED STATES, BY MINING DISTRICTS AND VARIETIES, 1924-25, IN GROSS TONS (EXCLUSIVE OF ORE CONTAINING 5 PERCENT OR MORE OR MANGANESE)

District	Hematite	Brown ore	Magnetite	Carbonate	Total	Pct. of increase or decrease in 1925
1924						
Lake Superior *	44,796,766	.....	44,953	.....	44,841,719	....
Birmingham	6,214,381	296,931	.....	.....	6,511,312	....
Chattanooga	376,693	171,004	.....	.....	547,697	....
Adirondack	.....	.....	197,437	.....	197,437	....
Northern New Jersey and southeastern N. York.	.....	.....	110,626	.....	110,626	....
Other districts	†714,460	†346,224	994,695	3,249	2,058,628	....
	†52,102,300	†814,159	1,347,711	3,249	54,267,419	....
1925						
Lake Superior *	52,056,663	.....	.....	.....	52,056,663	+16
Birmingham	6,312,207	323,599	.....	.....	6,635,806	+ 2
Chattanooga	259,843	96,877	.....	.....	356,720	—35
Adirondack	.....	.....	328,745	.....	328,745	+ 7
Northern New Jersey and southeastern N. York.	.....	.....		.....		
Other districts	†917,977	†464,124	1,143,259	4,703	2,530,063	+23
	†59,546,690	†884,600	1,472,004	4,703	61,907,997	+14

* Includes only those mines in Wisconsin which are in the true Lake Superior district.
† Some hematite included with brown ore.

IRON ORE SHIPPED FROM MINES IN THE UNITED STATES, 1924-25, BY STATES
(Exclusive of ore containing 5 percent or more of manganese and of ore sold for paint)

State	1924 Gross tons	1924 Value	1925 Gross tons	1925 Value	Pct. increase or dec'se Quantity	Pct. increase or dec'se Value
Alabama	6,557,596	$13,927,551	6,891,081	$14,134,677	+ 5	+ 1
California	435	*	352	*	— 19	....
Colorado	4,702	*	8,642	*	+ 84	....
Georgia	112,059	285,128	79,488	231,683	— 29	—19
Michigan	11,248,641	35,605,902	15,254,003	40,926,315	+ 36	+15
Minnesota	31,076,114	93,311,092	38,022,237	96,083,485	+ 22	+ 3
Missouri	79,847	405,622	40,043	*	— 50	....
Montana	3,913	10,846	3,672	10,244	— 6	— 6
New Jersey	101,123	420,488	164,523	678,021	+ 63	+61
New Mexico	189,371	*	172,959	*	— 9	....
New York	303,386	1,448,616	413,517	1,988,735	+ 36	+37
North Carolina	12,525	32,512	22,011	49,511	+ 76	+52
Ohio	244	*	2,410	*	+888	....
Pennsylvania	807,411	1,881,122	917,255	2,149,800	+ 14	+14
Tennessee	179,293	431,682	164,073	369,144	— 8	—14
Utah	164,154	234,348	268,529	361,251	+ 64	+54
Virginia	91,759	250,279	76,302	174,454	— 17	—30
Washington	1,700	*	830	*	— 51	....
Wisconsin	786,006	2,044,762	933,214	2,260,388	+ 19	+11
Wyoming	363,096	*	489,622	*	+ 35	....
Undistributed	.....	†1,017,155	.....	†1,379,178	.....	....
	52,083,375	$151,307,105	63,924,763	$160,796,886	+ 23	+ 6

* Included under "Undistributed."
† This figure includes value for states entered as "*" above.

PIG IRON SHIPPED FROM BLAST FURNACES IN THE UNITED STATES, 1924-25, BY STATES

State	1924 Gross tons	1924 Value	1925 Gross tons	1925 Value	Pct. increase or dec'se Quantity	Pct. increase or dec'se Value
Alabama	2,667,361	$55,791,228	2,910,370	$57,777,275	+ 9	+ 4
Colorado	*	*	*	*	....	....
Illinois	2,695,961	59,299,519	3,600,484	74,937,781	+34	+26
Indiana	2,571,411	52,507,720	3,350,747	64,807,575	+30	+23
Kentucky	99,055	*	153,935	*	+55	....
Maryland	539,188	*	693,523	*	+29	....
Massachusetts	50	*	.....	.....	....	....
Michigan	650,333	15,225,990	831,435	18,452,346	+28	+21
Minnesota	189,033	*	276,240	*	+46	....
Missouri	21,371	*	3,758	*	—82	....
New Jersey	*	*	*	*	....	....
New York	1,914,545	38,150,486	2,151,036	40,435,443	+12	+ 6
Ohio	7,434,487	159,701,131	8,857,615	173,418,068	+19	+ 9
Pennsylvania	10,962,288	237,052,035	12,537,809	258,140,674	+14	+ 9
Tennessee	126,660	2,782,154	95,186	2,014,176	—25	—28
Utah	*	*	126,746	*	....	....
Virginia	94,462	2,268,022	97,884	2,237,749	+ 4	— 1
West Virginia	453,944	9,884,019	499,047	9,416,095	+10	— 5
Wisconsin	172,435	3,945,369	226,712	4,836,952	+31	+23
Undistributed	†471,545	†28,471,299	†402,175	†32,842,199	....	....
	31,064,129	$665,078,972	36,814,702	$739,316,333	+19	11

* Included under "Undistributed." † Includes figures for states marked "*."

FERROALLOYS SHIPPED FROM FURNACES IN THE UNITED STATES, 1924-25

Variety of alloy	1924 Gross tons	1924 Value	1925 Gross tons	1925 Value
Ferromanganese *	232,821	$23,533,668	254,005	$26,006,439
Spiegeleisen	76,179	2,354,731	95,890	2,407,226
Ferrosilicon (7 pct. or more silicon)	150,021	7,558,984	221,387	11,405,060
Ferromolybdenum	107	254,970	210	236,957
Ferrotungsten	741	1,110,553	1,238	1,991,123
Ferrovanadium	1,355	3,641,724	1,841	4,843,635
Other varieties †	36,020	4,795,318	41,651	6,157,660
	497,244	$43,249,948	616,222	$53,048,100

* Includes a small quantity of silico-manganese.
† 1924: Ferrochromium, ferrophosphorus, ferrotitanium, ferrozirconium, and zirconium-ferrosilicon; 1925: Ferrochromium, ferrophosphorus, ferrotitanium, ferrouranium, ferroziconium, and zirconium-ferrosilicon.

gross tons; in 1924 it was 2.186 tons; and in 1923 it was 2.243 tons. Of the foreign manganese ore consumed in 1925, 207,238 gross tons was from Brazil and averaged 43.52 percent of manganese; Russia furnished 194,006 tons, averaging 48.17 percent of manganese; India 68,326 tons, averaging 50.42 percent; Africa 33,582 tons, averaging 46.97 percent; and the remainder was from Chile, China, Cuba, and Porto Rico and averaged between 42.44 and 52.75 percent of manganese. The average manganese content in the total foreign ore consumed in 1925 was 46.41 percent. The improvement in metallurgy in the manufacture of ferromanganese is evidenced in 1925 by the recovery of 80.36 percent of the metallic manganese contained in all ore consumed, whereas during 1918 a loss of from 10 to 40 percent of the manganese contained in the ore was entailed in the manufacture of ferromanganese.

PRODUCTION OF FELDSPAR IN 1925

THE crude feldspar sold or used by producers in the United States in 1925 amounted to about 184,100 long tons, valued at about $1,306,300, according to a statement prepared from reports received directly from producers and issued by the Bureau of Mines, in cooperation with the geological surveys of Maryland, New York, North Carolina and Virginia. These figures show a decrease of 10 percent in quantity and 13 percent in value compared with 1924. Feldspar was mined and sold in 1925 in 12 states, namely, Arizona, California, Colorado, Connecticut, Maine, Maryland, New Hampshire, New York, North Carolina, Pennsylvania, South Dakota and Virginia. The greatest feldspar-producing region is that which includes the Atlantic seaboard states, from Maine to North Carolina. This region reported about 93 percent of the total production and value in 1925. North Carolina, the leading state, reported about 41 percent of the total output; New Hampshire, the second state, reported 21 percent; and Maine, the third, 15 percent. The average value per long ton in North Carolina was $6.48; in New Hampshire, $7.28; and in Maine, $9.04.

CRUDE FELDSPAR SOLD BY PRODUCERS IN THE UNITED STATES IN 1924 AND 1925

State	1924 Long tons	1924 Value (b)	1925 (a) Long tons	1925 (a) Value (b)
Arizona	(c)	(c)	(c)	(c)
California	8,027	$62,344	6,000	$49,800
Colorado	(c)	(c)	(c)	(c)
Connecticut	6,572	51,422	10,300	71,200
Maine	29,912	271,354	28,400	256,700
Maryland	4,854	25,020	4,700	26,400
New Hampshire	39,425	324,638	38,300	278.700
New York	13,839	108,751	10,400	70,400
North Carolina	97,075	640,403	75,600	490,200
Pennsylvania	1,481	4,763	1,300	4,700
South Dakota	(c)	(c)	(c)	(c)
Virginia	(c)	(c)	(c)	(c)
Undistributed	3,587	20,644	9,100	58,200
Totals	204,772	$1,509,339	184,100	$1,306,300

(a) Figures for 1925 are preliminary and subject to revision.
(b) Value at mine or nearest shipping point.
(c) Included under "Undistributed."

Except for minor purposes feldspar is prepared for use by grinding. This work is done principally by commercial mills; only a very small portion is ground by users in their own mills. In 1925 there were 32 commercial mills operated in 13 states, namely, California, Colorado, Connecticut, Illinois, Maine, Maryland, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania and Tennessee. These mills reported 212,300 short tons of ground feldspar sold, valued at $3,597,800, or $16.95 a ton, compared with 189,780 short tons, valued at $3,283,170, in 1924, an increase of 12 percent in quantity and 10 percent in value. Of this quantity 184,300 short tons, valued at $3,011,800, or $16.34 a ton, was domestic feldspar, and 28,000 tons, valued at $586,000, or $20.93 a ton, was Canadian feldspar. Canadian feldspar was ground in three states in 1925—New York, Ohio and Pennsylvania. These figures represent increases in production and value of both domestic and Canadian feldspar as compared with 1924.

The production of crude feldspar by states in 1924 and 1925 is shown in the following table:
accompanying table

CALIFORNIA PETROLEUM INDUSTRY IN 1925

A STATISTICAL summary of the activities of the California petroleum industry during the year 1925 has been issued by the San Francisco office of the Bureau of Mines, Department of Commerce. The report, comprising 46 pages, contains data on production, storage, contains data on production, storage, consumption, stocks, etc.

INCREASED PRODUCTION OF PHOSPHATE ROCK IN 1925

THE total quantity and value of phosphate rock mined in the United States and sold in 1925 were 3,481,819 long tons, valued at $11,545,678, according to a statement made by the Bureau of Mines, which was compiled from individual reports furnished by producers. The figures indicate an increase of 21 percent in quantity and of 13 percent in value as compared with 1924.

The following table shows the quantity and value, by States, of the various kinds of phosphate rock mined in the United States and sold in 1925:

State	Long tons	Value
Florida:		
Hard rock	378,692	$1,448,526
Land pebble	2,551,272	7,340,544
	2,929,964	$8,789,070
Idaho:		
Western rock	65,934	289,498
South Carolina:		
Land rock	2,147	8,051
Tennessee and Kentucky:		
Blue and brown rock	477,077	2,429,059
Wyoming:		
Western rock	6,697	30,000

Imports of phosphate rock in 1925, which were 2,735 long tons, valued at $37,932, indicated a decrease of 83 percent in quantity, and of 79 percent in value. Exports amounted to 922,655 long tons, valued at $6,559,360, an increase of 13 percent in quantity and 28 percent in value.

PRODUCTION OF GRAPHITE IN 1925

THE graphite industry in the United States on the whole continued to decline in output in 1925, according to a statement by the Bureau of Mines, which has collected statistics on production in cooperation with the geological surveys of Alabama, Michigan, and Texas. The output in 1925 was 4,665 short tons, valued at $96,361. This was a decrease of 306 short tons, or 6 percent, but an increase of $8,851, or 10 percent, compared with 1924. The decrease in output was in the amorphous variety, crystalline graphite increasing in both quantity and value. The 1925 output of amorphous graphite amounted to 3,536 short tons (76 percent of the total graphite), a decrease of 535 tons, or 13 percent, compared with 1924. The value of amorphous graphite produced in 1925 was $39,640 an increase of 3 percent compared with 1924. The production of crystalline graphite in 1925 was 2,257,250 pounds, valued at $56,721, an increase of 456,925 pounds, or 25 percent, and $7,744, or 16 percent, compared with 1924. During the World War—both before and during participation by the United States—the graphite industry in this country flourished and reached its maximum from a standpoint of production and value. With the cessation of hostilities the demand fell off and the sales decreased markedly in 1919. In 1920, in line with the general prosperity, the graphite output increased but it fell off again and in 1921 was the lowest in quantity and value in many years. In 1922 and 1923 the trend was upward, only to drop off again in 1924 and 1925. The manufacture of artificial graphite at Niagara Falls, N. Y., increased considerably—from 10,986,192 pounds in 1924 to 12,135,655 pounds in 1925.

SCHOOL LAND GRANTS

(*Continued from page* 528)

sition of the public domain within their limits. They agreed to the exclusion of minerals in the grants for schools and other purposes.

THE MINING INDUSTRY—RECLAMATION

"The Government has withheld these lands from the States, from the railroads, and from all save the miner, under a law, simple, concise and certain, a law that is uniform throughout the public domain and that has stood the test of experience unchanged in its major provisions for more than 50 years. If these minerals and mineral lands are granted to the States, the prospector will be confronted by an ownership divided between State and Nation, and instead of one law extending equal opportunity to all, he will be confused by a multiplicity of laws, as many as there are States in which such lands are situated.

"The grant of minerals would also cripple reclamation. The act of 1902 devoted the proceeds of the public lands to the reclamation of the arid regions of the West. During the fiscal year 1925 more than four-fifths of the funds available for reclamation was derived from mineral leases. If any mineral lands are given away, the fund to carry on the work of reclamation will be proportionately limited. The Reclamation Fund is already so low, and the annual income to it so rapidly diminishing, that I must ask Congressmen interested in the new projects to agree on those to be built first, otherwise all of those now authorized can not be completed in an average lifetime.

"Titles to these school sections are uncertain because existing law makes no provision for patent or evidence of title to the States. I am convinced and have heretofore recommended that patents should issue to the States for all lands in place not known to be mineral at date of approval of survey, or when otherwise the right of the State would have attached; the States should be allowed to select other lands in place of those found to be mineral; and that the law, in order to expedite adjustment of the grants, should require that action be taken by the Government to determine the character of the land within a limited period, six years from the date of the new law, or in future, six years from the date of the approval of the survey, and that otherwise title should be passed to the States.

"No legislation effecting a change of policy so fundamental, involving resources of the Government as well as a great public trust, should be enacted without mature consideration. I hope a measure can be framed that will remove every difficulty in the way of an orderly and fair administration of the school grants to the States.

"The desire of the States for an early and final settlement of disputed school land titles is shared by this department."

PRESERVING MINE TIMBERS

(*Continued from page* 543)

as they accumulate each year, taking into consideration the gradual increased cost of the untreated timber and including interest at 6 percent each year. The curve shows that at the end of the 36-year period the total cost when using untreated timber is 53 percent more than the zinc treated timber and 60 percent more than creosoted timber.

The cumulated cost of the treated timber during the first three years will be more than if untreated material were used but at the end of the fourth year the cumulated costs of both zinc treated and creosoted are lower than untreated timber and from then on during the balance of the 36-year period great savings are possible as shown by Figure 7.

The comparative reduction of costs as shown in Figure 7 seems tremendous but I believe they are conservative for many mines can get more than 9 or 12 years from treated timber. There is a wonderful opportunity for making great savings by using treated timber; furthermore, timber that is partly decayed becomes an increased fire and accident hazard. By treating timber it is possible to cut down the tie and timber requirements of our mines and at the same time conserve our forests by reducing the quantities of material required each year. By conserving our forests we prevent the devastation of our grazing and agricultural lands by erosion.

Some of our mining engineers are talking concrete and steel without giving much thought to the use of treated mine timbers. They will spend months designing some mechanical equipment to reduce the cost of mining a few cents per ton or even a fraction of a cent but there is no problem which will show greater return on the investment than the use of treated mine ties and timbers. Just ask the railroad engineer—he knows.

DIATOMACEOUS EARTH AS AN INSULATOR

DIATOMACEOUS earth is one of the most efficient insulators known, and is supreme between the temperatures 204 degrees F. and 2,000 degrees F., states the Bureau of Mines in Serial 2718, recently issued. Although not quite so effective as some organic materials for low temperatures, it has the advantage of unchanging permanency, not being subject to decomposition or decay, by moisture, time or other agencies that affect ordinary organic matter. The insulating effect is due to the large number of minute enclosed air cells. Air is one of the poorest conductors of heat known, so that when it is prevented from transferring heat by convection it becomes an excellent insulator. To show the fine state of division of the air in diatomaceous earth it has been calculated that in one cubic inch there are 50,000,000 diatom valves, whose silicious content occupies only 20 percent of the actual volume. Diatomaceous earth will absorb as much as 80 percent of its own volume of water.

Diatomaceous earth is marketed for insulation as classified loose powder, as aggregate, as crude lumps, sawed crude brick and blocks, kiln-burned bricks and tile, composition bricks and blocks, pipe covering, etc. At present the material is mined almost entirely by open-cut methods. It is taken out in huge blocks which may contain by weight, three times as much water as diatoms. If the material is to be sold as sawed brick or blocks, it is cut to the desired size, otherwise the large blocks are dried directly. The wet material is stacked in the open and after 40 to 50 days hot, dry summer winds will reduce the moisture content to about 5 percent. Artificial drying has been used to some extent. Some sawed crude material is sold as such, other sawed material is kiln burned, other dried blocks are disintegrated by specially designed machinery, which pulverizes without breaking up the diatom valves. The powder is classified by elaborate pneumatic systems and the graded product sacked for shipping. Waste material too fine for drying is used for the manufacture of composition brick, blocks, cements, etc. The different grades of finished product have an apparent density of from 8 to 30 pounds per cubic foot.

GEORGIA CLAYS MAY DISPLACE ENGLISH KAOLINS

WASHED Georgia clays can be used to advantage to displace all of the English china clay in a vitrified dry-press body of small size, such as floor tile, it is indicated by tests made by the Bureau of Mines. Washed clay can be used to displace a portion of the china clay in a porous dry-press body such as wall tile up to about 20 percent of the batch. However, the extent to which the displacement may safely be carried depends largely upon the shape and size of the ware.

The color of ware made from a properly washed clay is about equal to that of ware from the usual grade of china clay, and it is only slightly inferior to that of ware from highest grade English clay and domestic primary kaolins.

DUST RESPIRATORS TESTED BY BUREAU OF MINES

A STUDY of various types of respirators designed as safeguards against the presence of injurious dusts encountered in mining and many other industries has been conducted by chemists of the Pittsburgh experiment station of the Bureau of Mines. Many industrial dust respirators, and many fabrics and filtering materials, including cheese cloth, canton flannel, bleached and unbleached muslin, filter paper, and absorbent cotton, were tested. The filtering efficiencies of the respirators were determined by passing air containing either tobacco smoke or suspended silica dust in minute particles through the respirator at varying rates. A small stream of the air that escaped from the respirator was viewed in a beam of light in a dark box. An equal stream of the unfiltered air was viewed alongside the first stream, and the unfiltered stream was diluted with measured portions of pure air until the two streams reflected light of equal intensity. In this way a measure of the filtering efficiency of the respirators was obtained.

The efficiencies of the industrial dust respirators in restraining tobacco smoke were found to range from 5 to 33 percent when the air was passed at a rate of 32 liters per minute. A gas-mask canister with two filters of absorbent cotton showed 63 percent efficiency. A flat felt filter was most efficient, with 97 percent.

The efficiencies against silica dust floated in air ranged from about 9 to 70 percent for the dust respirators. The silica particles were mostly 1 micron in diameter or four times the diameter of the tobacco-smoke particles. As the dusts most injurious to miners, stoneworkers, and many others engaged in dusty trades are about 1 micron in diameter, the respirators, if worn, can prevent inhalation of a considerable amount of dust, but not all.

While the laboratory study has shown that most dust respirators are not highly efficient in removing tobacco smoke from air, it has been found that a filter which removes 50 percent of tobacco smoke from air flowing at the rate of 85 liters per minute is very efficient in restraining ordinary industrial dusts, also smokes from burning wood or carbonacious material, such as those encountered by city firemen. Hence, 50 percent efficiency against the tobacco smoke by the laboratory tests has been adopted by the Bureau of Mines as a standard requirement, together with others, for approval of respirators or gas masks to afford protection from smoke or dust. Tobacco smoke was used in the experiments for the reason that, being extremely difficult to arrest, it tested the respirators severely.

As the laboratory tests performed on the dust respirators were severe, the low efficiencies do not indicate the general efficiencies of these respirators under all industrial conditions. Many of the industrial dusts are less difficult to restrain, and the overall efficiency of the respirators in actual service is correspondingly higher. The tests thus show that as a rule the respirators are very beneficial in removing such injurious dust from inspired air.

The discomfort caused by respirators covering the face, the heat engendered thereby, irritation of the skin at contact with the respirators, poor fit which allows leakage in some instances, or leakage at valves, and resistance to flow of the air breathed, are the most serious disadvantages of respirators. Resistances of industrial dust respirators were 0.25 inch to 1.5 inches of water to air flowing at 85 liters per minute. The flat felt filter had a resistance of 2.25 inches and the gas-mask canister 3.6 inches.

A man wearing a gas mask can work hard for only about half an hour, when on account of the extra exertion caused by the resistance to breathing, he must stop to rest or greatly reduce his exertion. Resistance of the dust respirators, although causing some discomfort, does not seriously interfere with a man's exertions until the filter becomes clogged with deposited dust and the resistance correspondingly increased. The filter must then be cleaned or freed of dust, or it must be replaced by a fresh one.

While the use of respirators should be encouraged among workers in dusty industries, the Bureau of Mines' tests show that respirators can not be considered a final safeguard. Effort should be continued in mines and other industries to prevent the formation and distribution of dust into the air, in mines particularly by the use of hollow drill steel and water and by sprays on the undercutting machines.

Further details regarding these tests are contained in Serial 2745, "Tests and Characteristics of Dust Respirators," by S. H. Katz, G. W. Smith and E. G. Meiter, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

NEWS OF THE MINING FIELD

A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field

Minnesota Royalty Tax Declared Valid

The validity of the Minnesota royalty tax was upheld by the United States Supreme Court in a decision handed down on June 7, sustaining the decision of the Federal Court for the District of Minnesota. This law provides for a tax of 6 percent on all royalties paid to lessees and owners of mines by active mining companies. It was enacted by the Minnesota Legislature in 1923. This legislature also enacted the occupational tax, which levies a tax of 6 percent on iron ore at the collar of the shaft. Known iron ore also pays a tax each year it lies in the ground in Minnesota.

Leasing of mineral lands constitute a distinct characteristic of mining in Minnesota, where virtually all of the iron ore is mined under royalty arrangements with the owners of the land.

The validity of the law was attacked in 1923 by the Lake Superior Consolidated Iron Mines and six other individuals and corporations, on the ground that it violated the Federal and state Constitutions because arbitrary and unreasonable, and was unequal in its application.

Payment has been withheld on the part of many fee owners since litigation started. Steps will be taken by the state immediately to collect these back taxes, amounting to over $2,000,000.

The latter part of May, mining men of Minnesota appeared before the state tax commission and made an urgent plea for a more liberal interpretation of the occupational tax law. Deductions for depreciation, fire insurance, or general office expenses are not allowable in arriving at the cost of producing iron ore under this law. They insist that such items of cost are clearly legitimate for deductions.

Bunker Hill & Sullivan Has Low Accident Rate

The Bunker Hill & Sullivan Co., at Kellogg, Idaho, led the state in the low percentage of accidents, minor and fatal, during the last year, according to figures recently compiled by the state mine inspector. With an average pay roll of 998 men, the accident rate was 0.19 accidents per 1,000 days per man, one of the lowest records ever hung up in the state of Idaho by a corporation employing a large number of men.

Tonopah Extension-West End Apex Suit Settled

The suit involving apex rights, brought by the Tonopah Extension Mining Co. against the West End Extension Mining Co. and its subsidiaries, was settled out of court June 12, at Reno, Nev., before the case came up for trial. Legal proceedings were instituted in October, 1924, in a suit brought by the Tonopah Extension, alleging trespass, and the case was set for trial at Goldfield, June 14. By the terms of the agreement West End Extension shall have the right to work the vein in controversy, known as the "76" vein, underneath the surface of the Panther and New Jersey claims of Tonopah Extension between specified parallel planes.

Nonferrous Metals in Automobile Industry

The American Bureau of Metal Statistics estimates the use of the principal nonferrous metals in the automobile industry in 1925 as follows: Copper, 106,400 tons (of 2,000 pounds), or 57 percent, compared with 93,700 tons, or 58.9 percent, in 1924; zinc, 21,200 tons, or 11.4 percent, against 18,700 tons, or 11.8 percent, in the previous year; tin, 15,000 tons or 8 percent, against 12,400 tons, or 7.8 percent, last year; lead, 12,800 tons, or 6.9 percent, against 10,700 tons, or 6.7 percent, in 1924; aluminum, 31,100 tons, or 16.7 percent, compared with 23,600 tons, or 14.8 percent.

The total consumption of lead in the United States for storage batteries is estimated for 1925 at 180,000 tons, of which 99,000 tons were used for automobiles, compared with 170,000 tons, of which 93,000 were used for automobiles, in 1924.

Callahan Zinc-Lead Mill

At a meeting of the directors of the Callahan Zinc-Lead Co. early in June, it was decided to proceed at once to build a flotation mill of 150 tons daily capacity at the Galena mine of the company in Lake Gulch, about 2 miles west of Wallace, Idaho. Mill tests had been made and plans and estimates prepared previous to the meeting of the directors, as had estimates of tonnage available in the mine for mill purposes. The Galena property is a consolidation of various groups of claims and carries silver, lead, and copper.

May Recover Zinc From East Helena Smelter Slag Dump

That a large profit can be secured from the slag dump of the East Helena smelter of the American Smelting & Refining Co. is the belief of Brent N. Rickard, manager of the plant. The slag is the accumulation of many years, and Mr. Rickard says that it contains at least 12 percent of zinc, which was lost in the treatment of lead ore containing zinc. Several carloads have been shipped to the Anaconda zinc refinery at Great Falls, where tests are being made. The research department of the East Helena smelter is also working on the problem. Mr. Rickard estimates that there are between two and three million tons of this zinc ore-bearing slag on the dump.

Zinc Plant For Bunker Hill & Sullivan

An electrolytic zinc reduction plant is to be built at Kellogg, Idaho, by the Bunker Hill & Sullivan Mining Co., at an estimated cost of $1,000,000. This project has been under discussion for several years, and final action toward its construction was taken the middle of June.

Stanly A. Easton, president of Bunker Hill & Sullivan, has announced that the plant will have a capacity of 50 tons of refined zinc per day, and that it will be planned with the view to enlarging its capacity as conditions warrant. The process to be used will consist of the Tainton electrolytic system with high acid strength and voltage density.

Idaho Inspector of Mines Issues Comprehensive Report

The Twenty-seventh Annual Report of the Mining Industry of Idaho, issued by Stewart Campbell, inspector of mines, is the largest and most comprehensive of any that have ever been issued, containing 272 pages compactly set in small type, five insert cuts of mill flow sheets, and numerous illustrations. It is a complete handbook of mining in Idaho and contains much information of value to those interested in mining and milling, as well as giving concise data on general mining conditions, mining companies operating in the state, and opportunities which the state offers for mineral development.

Each mining county is given a prominent place in a general review of the

work done during the year, the principal mining activities, a list of the minerals found in the county, and an expression of the mineral resources and mining possibilities that the county offers. The mining companies are listed by counties, and each company receives special mention, which includes its officers, capitalization, location of the mine, extent of mine workings, character of the mine, men employed, and a brief review of the work done during the year. The report also gives a general review of mining throughout the state during the year. This feature deals with each county and gives a complete resume of all the principal mining activities.

Another feature of the report is "Milling in the Coeur d'Alene." This subject includes a description, flow sheet, and pictures of a few of the important mills in that district. The articles are well prepared by those in charge of the mill, and should prove informative to anyone interested in mining and milling, as well as adding to the literature on flotation and milling methods.

Mr. Campbell's "Foreword" is a forceful statement of his position in encouraging the development of Idaho's mineral resources by protecting the public against fake promotions and dishonorable promoters. In this he outlines his position as well as exposing some of the methods used by the crooked promoters. The "Foreword" also calls attention to fake platinum assayers, and a warning is sounded for the public to beware of "predatory platinum assayers" and promotions based on their assays.

. The report also contains a special article by K. T. Sparks, director of the mine rescue station in the Coeur d'Alene district; a list of all the accidents which occurred in the mines of the state during the year; a summary of the number of men employed, and the wages paid; a bibliography which covers all the principal articles ever published on the geology, mineralogy, and mineral resources of the state; metal production statistics, arranged by counties for the year 1925; and also the state totals from 1903 to 1925.

Another interesting feature, which has proved of value in past reports, is the list of mining companies which have failed to comply with the laws.

The report is well illustrated with numerous views of mining scenes in various parts of the state. It is comprehensively indexed and well arranged. Copies of the report may be had upon request to the inspector's office at Boise, Idaho.

New Acid-Resisting Alloy

A new acid-resisting alloy has been developed by a Cleveland company. It is not a nonferrous alloy but a ferrous alloy in which iron makes up about 35 percent. The rest of the material is composed of about 35 percent nickel, 25 percent chromium, and up to 5 percent molybdenum. It is made by the Pioneer Alloy Products Co., Inc., Cleveland, which controls patents on the alloy. The claims are that it will resist practically all corroding liquids used in the chemical industry, with the possible exception of hydrochloric acid. It is already being used as a material for valves, cocks, pump parts, and pipe fittings in the petroleum and chemical industries.

Michigan Mine Valuations

The Michigan Tax Commission has reduced the values of the iron mines of Michigan $9,002,250 below the appraised valuation given for 1925. This is 8¼ percent reduction and a flat reduction of 5 percent below the tentative figures submitted early in May during the meeting of the commission in the upper peninsula. Total valuation is placed at $100,302,550 for 1926, and is divided among three ranges, giving Menominee range $27,701,100, Gogebic range $40,225,300, and Marquette $32,376,150.

Michigan copper mines are valued by the commission at $30,560,000, of which $20,370,000 is assessed in Houghton County and $10,190,000 in Keweenaw County. Calumet & Hecla Consolidated Mining Co. was assessed at $12,905,000. Champion and Copper Range Companies at $4,005,000, Isle Royale Copper Co. at $1,451,000, and Quincy at $1,400,000.

American Continent Takes 72 Percent of U. S. Iron and Steel Exports in 1925

The American continent was preeminent as a market for United States exports of iron and steel in 1925, taking nearly 72 percent of the total foreign shipments, a larger percentage of the trade than was absorbed in the continent during the preceding year, according to the Iron and Steel Division of the Department of Commerce. In 1924 North and South America took 1,151,943 gross tons of United States iron and steel, or 64 percent of the total exports.

Canada, the principal customer for United States exports of iron and steel, increased its takings by about 64,000 tons in 1925, taking nearly one-half of the iron and steel destined for the entire continent. Heavier shipments were also forwarded to Argentina, Chile, Colombia, Panama, Salvador, Uruguay, Venezuela, and the British West Indies. On the other hand, noticeable losses were sustained in the trade with Brazil, Guatamala, and Peru.

The British Isles constitute the leading individual market for American iron and steel in Europe, but shipments to them were not quite so heavy in 1925 as in 1924.

Advocates Mining of Coal on Cooperative Basis

At the meeting of the Southern Ohio Pig Iron & Coke Association, held in Cincinnati, the latter part of May, Prof. Frank A. Ray, consulting engineer, of Columbus, advocated the mining of coal on a cooperative basis in the bituminous regions, on a plan which he claimed would benefit both producer and miner, depending on the sale price of coal. In order to carry out his plan, he explained it would be necessary to use the 1917 wage scale as a basis. The miners would be paid a bonus on all tonnage sold above the average sale price in their respective districts. The plan as outlined by Professor Ray is similar to the one in force in the sheet-steel industry, where the amalgamated wage scale is paid.

It was the unanimous opinion of the other speakers at the meeting that some plan was necessary to net the producers a fair price for their product, or hundreds of mines throughout the country would be compelled to close.

Samuel A. Taylor, president of the A. I. M. E., spoke on the problems of stream pollution in the mining industry, and the work being done to remedy the situation.

Illinois Coal Associations Consolidate

The three operators' associations in Illinois were consolidated into a new organization known as the Coal Operators' Association of Illinois, at a meeting held in Chicago, June 8, and attended by representatives of the Illinois Coal Operators' Association, the Fifth and Ninth District Coal Operators, and the Central Illinois Coal Operators' Association. Rice Miller, of Hillsboro, was elected president; Herman C. Perry, of St. Louis, vice-president; C. L. McLaughlin, Chicago, secretary; and Luce H. Smith, Chicago, treasurer. The following were elected to the executive committee: L. H. Smith, Spring Valley Coal Co.; M. S. Peltier, Peabody Coal Co.; George B. Harrington, Chicago, Wilmington & Franklin Coal Co.; J. D. Zook, O'Gara Coal Co.; S. A. Shafer, Pana Coal Co.; E. C. Searls, Crerar-Clinch Coal Co.; O. L. Lumaghi, Lumaghi Coal Co.; M. S. Coleman, Saline County Coal Corporation; and F. S. Pfahler, Superior Coal Co.

Mine Workers Denied Injunction to Enforce Wage Scale

An injunction to enforce the provisions of the Jacksonville wage agreement was refused the United Mine Workers of America in a decision by Judge I. G. Lazzelle, of the Circuit Court of Monongahela County, W. Va., June 9. Representatives of the United Mine Workers sought, in a complaint filed May 7, to restrain the Connellsville By-Product

Coal Co., the Arkwright Coal Co., the Pursglove Coal Mining Co., and the Cleveland-Morgantown Coal Co. from operating their mines on a nonunion basis and on a lower wage scale than that prescribed by the union.

Judge Lazzelle held that where a number of individuals signed a contract without stating their connection with the United Mine Workers of America and another set had signed it as individuals without stating their connection with the defendant coal companies, which were specifically named in the petition, such a contract could not be held valid or enforceable.

In dealing with that phase of the complaint in which it was sought to prevent the employment of any but union miners, Judge Lazzelle declared that courts have recognized fully the right to collective bargaining, but the time had not arrived when a few men could sit down and sell the labor of thousands without their consent and compel them to work. Every man, he said, has a right to work wherever he pleases, for what compensation he pleases, and to quit work whenever he deems it right.

In connection with the request for an injunction to restrain eviction of miners from company houses, the court held that there had been no allegation that there was not an adequate remedy at law for a grievance of this sort.

Ohio Union Bans Cooperative Mining

The Ohio union of the United Mine Workers has issued an order forbidding its members from participating in cooperative mining operations in all sections of the state. This action came about as the result of a mass meeting held at Nelsonville. Later reports, however, indicate that very little attention has been paid to the order, with the exception of a few of the smaller operations.

Cooperative coal mining ventures in Ohio and near-by districts have been in vogue for some time as the only alternative to the Jacksonville wage scale, and a considerable tonnage has been produced in that manner. Union miners produce the coal, it is sold on the market, and the profits are divided. Union officials object because they claim the wages received by the miners are not equal to those paid under the union scale.

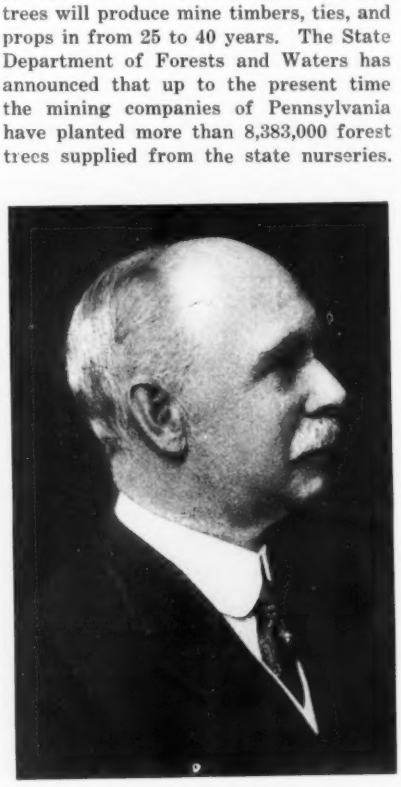
West Virginia Coal Association

At the annual meeting of the West Virginia Coal Association, held at Charleston, June 1, the officers of the association were reelected, as follows: J. G. Bradley, Dundon, W. Va., president; G. M. Caperton, Charleston, vice-president; C. C. Dickinson, treasurer; W. H. Cunningham, Huntington, secretary; and James E. Hart, Huntington, assistant secretary.

The operators were unanimously opposed to any form of governmental legislation that would attempt to control or interfere with the natural operation of the bituminous coal industry.

Reforestation in Pennsylvania

During the spring 37 mining companies of Pennsylvania planted more than 1,565,000 trees on their property. These trees will produce mine timbers, ties, and props in from 25 to 40 years. The State Department of Forests and Waters has announced that up to the present time the mining companies of Pennsylvania have planted more than 8,383,000 forest trees supplied from the state nurseries.



D. W. Brunton

David W. Brunton, Past President of The American Mining Congress, and prominent Colorado mining man was the recipient of an Honorary Degree of Doctor of Science, by the University of Colorado.

Mr. Brunton is one of the most prominent mining engineers of the country. He has engaged in his profession in Colorado since 1875. He is chairman of the board of consulting engineers of the Moffat tunnel commission and also Past President of the American Institute of Mining Engineers.

Manufactured Fuel

Establishments engaged primarily in the production of manufactured fuel—briquettes and boulets—in 1925 reported to the Department of Commerce a total output valued at $5,892,030, an increase of 5.5 percent as compared with 1923, the last preceding census year.

Of the 13 establishments reporting for 1923, 3 were located in Pennsylvania, 2 in California, 2 in Virginia, 2 in Wisconsin, and 4 in other states. In 1923 the industry was represented by 15 establishments, the decrease to 13 in 1925 being the net result of a loss of 5 and a gain of 3. Of the five establishments lost to the industry, four had gone out of business prior to the beginning of 1925 and one reported manufactured fuel as a secondary instead of a primary product for 1925 and was therefore transferred to another industry.

Coal in the Philippine Islands

Almost every island in the Philippines and the majority of the provinces are known to contain coal, according to a report to the Department of Commerce. Development of coal deposits has taken place in Cebu, Zamboanga, and Batan Islands. Most of the coal discovered so far is lignite, but some high-grade bituminous coal has been found, and there is some production of anthracite.

The coal fields on the above-mentioned islands cover an estimated area of 58 square miles and are estimated to contain at least 68,000,000 short tons of coal. While the coal can be used for industrial purposes, it is not suitable for bunkers. Aside from bunkers practically the only demand is from public utility companies.

Anthracite coal is found in commercial quantities in the Philippine Islands, and the production is increasing each year.

Submarine Tin-Mining Project in Dutch East Indies

The Government of the Netherlands East Indies has for some time past been considering the exploitation of the tin-bearing areas on the sea bottom in the immediate nieghborhood of the Island of Banka, according to reports to the Department of Commerce. This is a result of the reported gradual exhaustion of the tin deposits on the island.

An opportunity to make a start in this undertaking was offered the Government with the dredging of a channel near Tobali, on the south coast of Banka, in january of this year. It was then decided to bring the submarine tin deposits to the surface for delivery to the Government mining industry on the island. This is believed to be the forerunner of a systematic exploitation of the tin deposits on the sea bottom in the near future. A proposal to this effect has already been made to the Government.

National Wealth and Income

The Federal Trade Commission, in response to a Senate resolution, has issued a report on national wealth and income, which estimates the national wealth in 1922 at $353,000,000,000 and the national income in 1923 at $70,000,000,000. The increase in national wealth from 1912 to 1922, as measured in dollars, is reckoned

in the report at about 72 percent, but it is stated that if allowance is made for changes in the purchasing power of the dollar, the real increase was nearer 16 percent as compared with about 15 percent increase in population.

As to the ownership of national resources, the report estimates that for 1922 six companies controlled about one-third of the developed water power, eight companies three-fourths of the unmined anthracite coal, 30 companies over a third of the immediate reserves of bituminous coal, two companies over one-half of the iron-ore reserves, four companies nearly one-half of the copper reserves, and 30 companies about one-eighth of the petroleum reserves.

To Build Refinery at Craig, Colo.

The Texas Company has definitely decided to build a new refinery at Craig, Colo., the plant to have a capacity of 1,000 barrels daily, and costing $350,000. The Craig to Casper shipments of crude oil by the Texas Company place a heavy overhead on the expense of refining this oil from the Moffat field; by refining the oil at Craig the cost of transporting the oil products to the market would be reduced. This will be the first refinery of the Texas Company in Colorado. Their Casper plant has a capacity of 10,000 barrels daily.

Calumet & Hecla Construction Program 75 Percent Complete

The construction program of Calumet & Hecla Consolidated Copper Co., which has been under way for two or three years, is more than 75 percent complete, but several large items remain. Chief among them is smelter improvements, and most important is the installation of a casting machine, a unit of one of the three large furnaces. It is expected that the smelter changes will be completed by 1927. Reclamation plants at Tamarack and Lake Linden are operating at capacity, and the 1926 output will at least equal that of 1925.

Oil and Gas Ruling by Internal Revenue Bureau

The general counsel for the Internal Revenue Bureau, Treasury Department, has ruled that a gas lessee is entitled to discovery value on gas wells discovered by oil lessees and taken over by the gas lessee under Federal regulations governing contemporaneous leases on the same property. The ruling is based on section 214 A of the revenue acts of 1918 and 1921, and is to the effect that a gas lessee of property on which there exists a contemporaneous oil lease is entitled to discovery revaluation for depletion purposes as to all wells discovered on its leasehold tract and taken over from the oil lessee under lease option. The decision is to the effect that this action should be taken whether payment was made by immediate reimbursement of the oil lessee for development costs or by payments under the gas contract.

Hearing on a petition for adjustment downward of oil royalties on oil and gas permits in San Juan County, Utah, was held by the Interior Department June 18. The holders of oil and gas permits claim they are located 185 miles from a railroad and are unable to pay the same royalty as producers close to transportation. They said royalties should not exceed 20 percent of the oil and gas produced on permit lands located far distant from a railroad. Salt Lake attorneys represented petitioners.

Dusts Available For Rock Dusting Coal Mines

Any incombustible powder may be used for dusting coal mines as a means of preventing coal dust explosions, but some materials are much more desirable than others, states the Bureau of Mines. Chalk is used quite extensively in France. Roof shale is used in England, but coal mine roof material in the United States is not generally suitable as it is often sandy or contains too high a percentage of inflammable material. Exhaustive studies made by the Bureau of Mines indicate that siliceous dust would injure the health of the miners. Some American roof shales may not be injurious. A study is now being made by the bureau to determine the suitability of roof shales for dusting purposes.

Dark colored dusts are not desirable. They can not be distinguished from coal dust readily, and it is not easy to judge the amount of inert dust present, or how completely the coal dust may be blanketed by the inert powder. A white dust, on the other hand, contrasts with coal dust distinctly, and the proportion of inert material present is more readily estimated. White dust has the added advantage of improving the lighting of mines.

The dusting material must be obtainable at very low cost or the expense of dusting would be so great as to prohibit the use of the method.

A dust that is desirable, therefore, is white, incombustible, non-siliceous, and inexpensive. In view of present high freight rates the desired material should be obtainable near the coal mine.

Materials that seem to promise fulfillment of the conditions named are limestone, gypsum, and anhydrite. Limestone is essentially carbonate of lime, and its dust is not considered injurious to the lungs of miners. It grinds to a white or light gray powder, is abundant, and usually may be procured at low cost. Gypsum is a hydrous calcium sulphate; it grinds to a white powder, is not injurious as a dust, and is fairly low-priced, though not as abundant or as generally distributed as limestone. Anhydrite is the anhydrous form of calcium sulphate and occurs in varying quantities in many gypsum mines. It is harder than gypsum, gives a white, non-injurious powder, and as it is largely a waste material it might be cheaper than gypsum in some localities.

Labor Head Declares Against General Strikes

General strikes which would involve the violation of wage agreements were condemned by William Green, president of the American Federation of Labor, in an address in Denver, June 15.

A general strike, he said, means that the line of industrial conflict is immediately changed so that it seems to become a contest between employes and Government rather than between employes and employers. He contended that the real issues of the strike are lost sight of in the maelstrom of public opinion and public inconvenience. The original grievance which caused the general strike, no matter how meritorious, must remain unsettled until after the general strike is ended. This, he declared, works untold hardships and makes more difficult the bringing about of a sound adjustment of the real grievance.

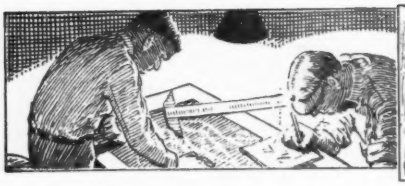
Would Have Canada Use Canadian Coal

The Canadian Provincial Premiers, meeting in Ottawa to investigate Canada's fuel problems, recommended that the Federal Government make a determined effort to have Canada supplied with Dominion-mined coal instead of importing the product.

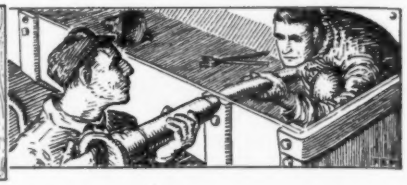
One suggested plan was the establishment of coke ovens throughout the Dominion. Another called for granting special freight rates for Canada's coal over the state-owned railway.

Fire at the Poland coal plant of the Maple-Sterling Coal Co., in Greene County, Pa., late in May destroyed two tipples, two coal bins, two dumps, three motors, and the entire conveying and loading system, with an estimated loss of $40,000. Officials of the company plan to rebuilt immediately.

A special train containing owners of coal-consuming factories in Cleveland, Akron, Canton, and Kent visited the eastern Ohio coal fields the middle of June as part of the "Use-Ohio-Coal Campaign." The mine owners financed the trip.



WITH THE MANUFACTURERS



Cylinders Mounted at Right Angles Give Perfect Balance to Air Compressors

Construction jobs, factories, shipyards, mills, foundries, railroad shops, municipal water works, quarries and mines find excellent use for the Angle Compound Compressor, type WJ-3, manufactured by the Sullivan Machinery Co., of Chicago, Ill. This motor-driven machine, of capacities ranging from 400 to 800 cubic feet, has perfect balance and is free from vibration.

The distinctive feature of this Angle Compound design is that the high-pressure and low-pressure cylinders are mounted at right angles to each other, and both pistons are actuated from one crank so as to give perfect balance of reciprocating forces. The air is compressed first in the horizontal cylinder, and then travels through a three-pass, counter-current, water intercooler to the vertical cylinder, where it is further compressed. Wafer inlet and outlet valves and automatic lubrication insure uninterrupted operation. The machine may be driven by belt or direct connected to a Westinghouse motor.

Another compressor type WN-4, which is composed of two WJ-3 compressors mounted side by side and driven from the same power unit, is built in sizes of 900 to 3,700 cubic feet. When the demand for air is light, either compressor may be operated efficiently alone with the other one standing still.

A smaller machine than the angle compound, and one that has capacities from 68 to 1,472 cubic feet, is the WG-6 compressor. It consists of a single air cylinder securely bolted to a sturdy frame which carries a crankshaft having a belt pulley on one end and a flywheel on the other. All moving parts are inclosed to exclude dust and grit, and lubrication is automatic. Drive is ordinarily by belt, but where floor space is limited direct connection to the Westinghouse motor is provided. "Wafer" inlet and discharge valves are standard equipment. Where running water is not available, this compressor is supplied with a hopper jacketed cylinder so that the hopper can be filled from a hose or bucket.

The "WH-6" Compressor is similar to the "WG-6" only the air is compressed in two stages instead of one. Capacities from 340 to 445 cubic feet.

These compressors due to their sturdy construction and the design that produces economic operation are able to save time and labor and produce efficient work where it is necessary to pump water, operate machines, or for cleaning purposes.

A Word About Shovel Types and Uses

The Marion Steam Shovel Co. recently sent out a report of an interview with a prominent designer of power shovels, who made the following comments on the natural grouping of shovels by types and capacities:

Marion Railroad Type Shovel of modern design. Electrically operated and mounted on crawlers. A powerful, rugged type

"For all practical purposes there is no general utility power shovel outside what is known as the small revolving class with capacities ranging up to 2 cubic yards. That is the range in demand by contractors, and contractors, broadly speaking, are the only users of general purpose shovels. Few general contractors own or want shovels larger than 2 cubic yards capacity at the outside. The whole thing is merely a matter of economics. Thus contracting shovels fall automatically into a well-defined group within what may safely be regarded as an arbitrary capacity limit of 2 yards or less.

"Beyond this group of contractors' shovels there is practically no field for all purpose or general utility shovels. Shovels larger than 2 cubic yards capacity are practically always bought for a specific use. And, because uses for larger shovels are so widely varied, it has brought about the establishment of two distinct types for the various kinds of heavy duty service. These are the heavy revolving type and the railroad type.

"The railroad type shovel is without question by far the more economical and productive on several types of service where the operating radius is restricted and the material heavy and obstinate. It is impossible to design a revolving shovel to take the place of a railroad type. There are good reasons why, else there would be no railroad type shovels built. One reason is that a revolving shovel, to take the place of a railroad type, must be made so compact as to infringe upon the proper diameter of the roller path, thus sacrificing stability in the face of service which requires the utmost stability. This is something that can not be overcome by counterbalance, for a counterweight heavy enough to impart stability to a small roller path shovel in rock would be too heavy for multi-purpose work. Furthermore, the railroad type shovel has an inherent advantage for close quarters work in its short boom and dipper stick. Due to the shortness of the swing as compared with a revolving shovel of equivalent dipper size, a railroad type shovel is far faster in loading out. A railroad type shovel can rapidly load and swing in quarters so narrow that its cab may be but a few feet from the parallel bank face—it might be against the face, for that matter—while manifestly swinging would be impossible for a revolving shovel under those conditions.

"So where the digging is hard and the demands heavy, there is no revolving shovel that can equal or even approach the railroad type.

"But for the much broader range of uses where the operating radius is wide and the face high, in fact, in all places where there's 'room for the tail where the head ought to be,' the larger square built, no compromise, revolving shovel is the thing.

"Thus do power shovel manufacturers find it necessary to build three distinct

groups of machines: The small revolving group with capacities up to 2 cubic yards, the railroad type in several sizes, and the larger revolving group."

Better Cutter-Bits Reduce Mining Costs

Recent improvements in the method of making coal mining machine cutter-bits have greatly increased the speed of making the bits as well as improving the wearing qualities of the bits themselves. Some five years ago a machine which rolled cutter-bits to the proper shape, length, and angle by means of a roller die operating on the principle of a machine shop shaper, was invented by engineers of the Sullivan Machine Co. This device has been in increasing use at coal mines in many sections since that time. The primary saving accomplished by these machines has been in the blacksmith shop, where the amount of labor necessary to make bits has been greatly reduced, not only because of the speed and accuracy of the machine but also because of the smaller number of bits needed to cut a given tonnage.

Other advantages which have been commonly noted include the following:

Every bit is a perfect one and each is an exact duplicate of every other.

Power is reduced in cutting coal. Estimated averages indicate savings of 20 percent per square foot undercut.

The capacity of the mining machine is increased.

There is less stress and strain on the mining machine with consequent reduction in upkeep and cost.

Fewer cutter bits are used, and there is no waste of steel in the blacksmith shop as was formerly the case with methods which required cutting off a piece of metal from the old bit before making the new one.

Three different improvements may be noted, all of which have been made within the past year.

SWAGING DEVICE

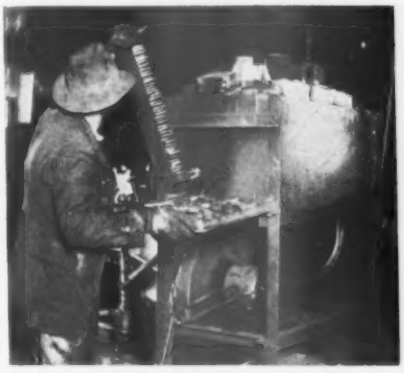
After the bit blanks for new bits are heated, having previously been cut from bar stock at an angle of about 30 to 45 degrees, they are placed in a flatter or swaging die which has been located at the left-hand side of the machine. In this swage the point is brought down to 1 inch in width. After this the bits are placed in position for rolling. By this method all fins or ridges on the edges of the bit are eliminated and only two or three strokes of the roller are required for making a new bit from the blank. In the case of badly worn or broken bits to be resharpened, these may also be swaged down to prevent forming fins during the resharpening. The action of this swage reduces time under the roller and also cuts down wear on the roller and die.

TIMING DEVICE FOR TEMPERING

It is often customary and sometimes necessary to temper the bits without reheating them. A new ejector and timing arrangement have been added to the Sullivan sharpener which makes it possible to secure any temper required without reheating.

AUTOMATIC BIT HEATER

The automatic bit heater, manufactured by the Mines Equipment Co., Arcade Building, St. Louis, has been found to have the following advantages when used in connection with the Sullivan bit sharpener:



Sullivan Automatic Bit Heater, Illinois Coal Corporation, Nokomis, Ill., showing man loading the gravity chute

Correct Heating. — The heater is equipped with a gravity steel chute and with a lever by means of which the bits are advanced one bit width at a time into the furnace. As the bits reach the hot end they are automatically discharged down a chute to within easy reach of the sharpener operator's tongs. The hearth is arranged so that the end of the bit only is sharpened in the fire. The shank of the bit is not heated, consequently is not tempered. This gives an ideal arrangement for mining machine work, as the shank of the bit is relatively soft, effecting a considerable saving in the cost of set screws, and reducing the number of lost bits.

Low Fuel Cost.—The cost of oil used per day is in most cases less than the cost of other fuel plus the expense of handling.

Rapid Heating.—Only seven to ten minutes are needed to get hot bits from the time of starting the cold furnace. The furnace will heat as many as 600 bits per hour if that rate is needed. No auxiliaries such as motor, blower, or air compressors are required. The machine is complete and ready to run. It is not necessary to operate any other part of the shop in order to run the furnace and sharpener.

Labor Economy.—While it is customary practice for two men to work as a crew with the furnace and sharpener, one feeding new bits into the chute and extracting completed bits from the tempering bath, etc., while the other operates the sharpener and the two changing off from time to time, one man can operate the heater and do the sharpening at the same time, in many cases saving the labor of a man, and in others where only one man is now used, securing a considerable increase in the number of bits sharpened. This arrangement is made possible by bringing the push lever for operating the furnace within reach of the sharpener operator's foot, so that without changing his position he can eject a bit from the hot end of the furnace within reach of his tongs and carry the bit on the hearth along one position, making room for a fresh bit at each pressure of the lever. With this combination one man can sharpen 1,800 to 2,400 bits per day of nine hours, while two men working together will handle 4,000 to 5,000 bits, all uniform in shape, perfect as to angle and length of point.

The Bureau of Mines, in its investigations of gas masks for use in mines and allied industries, tests masks that are voluntarily submitted by manufacturers for examination, and issues approval certificates for masks that meet the bureau's specifications. Serial No. 2750 describes the tests that were conducted on an ammonia gas mask by the Bureau of Mines, which successfully met all requirements and tests for ammonia gas masks. The mask tested, known as the GMD ammonia gas mask, is manufactured by the Mine Safety Appliances Co., Pittsburgh, Pa.

Illuminating Gas for Metal Cutting

Illuminating gas to replace acetylene, hydrogen and other fuel gases in combination with oxygen for metal cutting has been adopted at the Schenectady plant of the General Electric Co. following a comprehensive study of the economic needs of the various clasess of work. A special oxy-illuminating gas torch was developed for the purpose, and is now being used for the cutting of risers in the steel foundry of that plant, varying in thickness from 1 to 20 inches.

This method is also used, according to an article in the General Electric Review for June, on machines in cutting intricate shapes from steel plate.

The advantages of the use of illuminating gas were found to be (1) availability, (2) elimination of delays and handling of tanks, (3) low cost, (4) safety, and (5) chemical and physical properties permitting its use in a torch equipped with a superheater, thus effecting marked economies in the amount of oxygen required by the cutting jet.

The Oil-Electric Locomotive Invades Another Field

The oil-electric locomotive, which has established an enviable reputation for itself in railroad switching service in the East and Middle West, will now be applied for industrial and short-line freight service. The Red River Lumber Co. will place a 100-ton oil-electric locomotive in service about July 15, and the Utah Copper Co. will place a 60-ton unit in service at Bingham, Utah.

The 100-ton locomotive of the Red River Lumber Co. will be employed in hauling logs out of the woods and hauling supplies in over a line 15 to 20 miles in length. Maximum grades of 2 to 3 percent will be encountered. It will probably be necessary to cut the trains and take them in sections over these grades, the number of cars in each section depending on the amount and length of the grade.

The 60-ton locomotive purchased by the Utah Copper Co. will be employed in hauling waste cars on the upper levels at its mine at Bingham, Utah.

The locomotive which is being obtained by the Red River Lumber Co. is similar to those of the Long Island Railroad and Great Northern Railway; the smaller locomotive for the Utah Copper Co. is like those of the Ceneral Railroad of New Jersey, Baltimore & Ohio, Lehigh Valley, Chicago & Northwestern, Reading, Erie, and Delaware, Lackawanna & Western Railroads. In addition to these 60 and 100 ton units, larger oil-electric locomotives are being constructed for the New York Central Railroad.

The oil-electric locomotive is a joint development of the American Locomotive, Ingersoll-Rand, and General Electric Companies. Briefly, it is one in which an Ingersoll-Rand internal-combustion oil engine, using low-grade fuel oil, drives a General Electric generator which furnishes power to electric motors geared to axles of the driving wheels. Its advantages are much more economical and speedier operation, and absence of noise and smoke.

In locations where complete electrification is not advisable, due to infrequency of traffic or other causes, the oil-electric locomotive is particularly applicable, because of low cost of operation and maintenance, ease of manipulation, and the saving of time lost in refueling, advantages which hitherto have not been available except with the electric locomotive.

Two sizes of the oil-electric locomotive have been built; the first weighs 60 tons, and second 100 tons. Both of these units are primarily intended for switching and industrial service, but the design has no limits in power or speed. Plans have been drawn for the construction of oil-electric locomotives of greater power, approaching the maximum power of the largest modern steam engine.

There are several features of the oil-electric locomotive that are of particular advantage in industrial fields. Industrial plants are not generally equipped with shops and facilities for the convenient and economical repair of locomotives. As a consequence, the maintenance of steam locomotives is higher than would be the cost of the same locomotive on steam railroads. The parts of the oil-electric locomotive are small, convenient of access, and as a consequence the maintenance of such a locomotive, as compared with a steam locomotive, would be even more economical in an industrial plant than on the ordinary steam road.

In industrial plants the switching service is frequently intermittent, even more so than at large steam railway terminals. In all cases of intermittent service it is a fact that the steam locomotive is using fuel during all the period when the steam pressure is kept up. On the other hand, the oil-engine locomotive uses fuel only during the period when it is exerting power and only in proportion to the power used. As a consequence, the more intermittent the service, the greater is the advantage of using an internal-combustion type of engine in the power plant.

The tracks of industrial yards are not generally maintained in as good repair and alignment as those in steam yards. The swivel-type construction of the oil-electric locomotive gives it a flexibility, when compared with the rigid wheel base of the steam locomotive, which makes it more suitable for such uneven types of track, gives it better traction possibilities, and tends to reduce the maintenance of both the locomotive and the track.

In addition to the saving in fuel through the use of heavy oil, the oil-electric locomotive eliminates turntables, roundhouses, water towers and troughs, hostling service, the handling of coal and ashpits.

Of particular interest is the control equipment, which is of the progressive series parallel magnetic contactor type. This consists of three units; namely, master controller, contactor group, and protective relays and a resistor. The master controller—small, compact, and easily operated—is of the drum type and handles control current only on the main cylinder and full motor current on the reverse cylinder. Six solenoid operated contactors are used to make or break connections in all power circuits when current is on. Overload protection is provided by two overload relays, one placed in each side of the line, these relays being reset by a switch contained in the master controller, which also contains a switch for controlling the headlight circuits. The resistor is made up of cast grids enclosed in a permissible compartment.

The use of this type of control on this locomotive is particularly advantageous because it operates reliably with a minimum of inspection. This is an important factor with totally enclosed equipment.

New Locomotive for Gaseous Mines

Government approval No. 1513 has recently been granted by the Bureau of Mines to the General Electric Co. covering a permissible storage-battery locomotive for use in gaseous mines.

The approved locomotive has a rated weight of 6 tons and is intended for gathering service. It is of the outside frame construction, having the weight of the locomotive supported from the journal boxes on heavy semielliptical equalized springs. The motors are of the box frame type, spring suspended from the locomotive frame, and drive the axles through single reduction spur gearing.

J. McA. Duncan Made Assistant General Sales Manager of The Westinghouse Co.

According to an announcement by E. D. Kilburn, vice president and general sales manager, Mr. J. McA. Duncan, for 14 years Fittsburgh district manager, has been promoted to assistant general sales manager of the Westinghouse Electric and Manufacturing Co. Mr. W. R. Marshall, formerly branch manager of Buffalo, has been selected to assume the duties of Pittsburgh district manager. These appointments are effective May 1st.

Mr. Duncan, who has been in the employ of the company for 40 years, has worked in almost every department. This wide experience, coupled with unusual executive ability eventually led to his recent appointment.

In addition to these appointments, Mr. H. F. Boe, formerly industrial division manager at Buffalo, has been promoted to branch manager, of that office, and Mr. R. L. Kimber to industrial division manager. W. F. Barnes is appointed branch manager of the Tulsa office of the Westinghouse Company.

Using a gas-engine driven electric-arc welding outfit with 1,000 feet of cable between the generator and the electrode, a successful welding demonstration was recently staged on the west coast. The Southern Pacific Railroad Co. needed welding equipment that would weld with 3/16-inch high carbon steel electrode and furnish sufficient heat through 2/0 cable 500 feet from the set.

A test was therefore arranged by the Brown Brothers Welding Co., of San Francisco, at the plant of the Pacific Coast Steel Co. A General Electric type WD-12 welder was used with 1,000 feet of old cable with loose joints. The electrode holder cable was fastened to the extension cable by laying it across and taping it, and the connection to the ground plate was made through an old bolt shoved into a hole in the plate with a piece of iron laid against it to keep it from dropping out.

During the first test 3/16-inch electrode was used and some fine beads were laid, drawing about 200 amperes from the set. Some ¼-inch electrode was next tried and was used successfully.

Such a test is remarkable in view of the fact that it is seldom necessary to work at a distance of 500 feet from the set.

The Milburn Paint Spray

Paint spraying is the modern, economical method of applying paint, varnish, etc., to all surfaces. In painting any character of devices or surfaces, time, material, and labor costs are greatly reduced with the utilization of the proper gun or spray.

The ease and simplicity of operation of the Milburn paint spray is an outstanding feature. The paint enters a large, annular chamber surrounding the air nozzle from which it is atomized and expanded in a venturi-shape. The atomization is complete and is regulated by a mere turn of the nozzle, from a small to a large spray, or is entirely shut off, bringing into play a stream of air for dusting purposes, increasing the speed of the work. A pressure of 40 pounds is excellent, but this can be varied to suit the work. Carbonic gas tanks are also employed with good results.

The thorough, minute atomization of paint results in a complete even covering of a greater surface with minimum paint consumption. One coat is adequate with the Milburn atomization principle, where two coats are usually required by hair brushing. Air pockets and daubing are eliminated; places impossible to reach by brush can be painted with the Milburn spray.

It is light in weight, compast, and extremely efficient, employing a new and greatly simplified principle of construction, which accounts for its absence of moving parts and passages likely to clog. It consists of rugger cover, body, atomizer, and convenient handle. No small parts to get out of order or adjust.

A few of its many uses are for painting walls, interior and exterior; painting and varnishing woodwork, tanks, structural iron work, stacks, etc.; coating cement floors and walls to prevent cracking, dampness, etc.; painting automobiles, mechanical devices, etc.; cement, brick, and stucco; whitewashing; oiling and parafining motors, steel, baking pans, inaccessible machinery parts; and applying coatings to surfaces.

Timken Expansion

Announcement has just been made that $1,500,000 is to be spent in expanding the Canton plant of the Timken Roller Bearing Co. Building plans have been completed and the new units are to be completed by January 1, 1927.

In the past Timken scientists have been successful in developing such features as the tapered bearing design, the "positively aligned rolls" of Timken bearings, and the special electric furnace steel which only Timken produces, in its own complete steel mill. The output of electric furnace steel from the Timken mills is the largest in the world. Steel is required for production at the incredible rate of 132,000 Timken bearings daily. The total of Timken bearings universally applied has reached 150,000,000.

Effective May 22, Mr. H. E. Gilmore will become manager of the St. Louis branch of the Timken Roller Bearing Service & Sales Co. Mr. Gilmore's promotion follows several years sales experience with this company under the direction of Frank J. Lemper, manager and district supervisor of the Chicago branch.

The Omaha branch office of the Timken Roller Bearing Service & Sales Co., formerly located at 2524 Farnum Street, now occupy larger quarters at 2240 Douglas Street. Complete service stocks for authorized distributors will be maintained as in the past. The management will continue under the direction of A. D. Hackim.

The new home of the Los Angeles branch of the Timken Roller Bearing Service & Sales Co. will be at 1361 South Figueroa Street, moving to this location from 1241 South Hope Street.

The phenomenal growth of sales of Timken bearings for industrial uses has brought about the promotion of G. W. Curtis from industrial equipment engineer to district manager of sales, industrial division, for the Milwaukee territory. Mr. Curtis will work with R. W. Ballentine, who previously had handled this territory. Mr. S. M. Weckstein succeeds Mr. Curtis as industrial equipment engineer. Mr. Weckstein has been notably successful in developing Timken bearing applications for precision work in machine tools and high-speed applications. G. W. Richards and A. R. Spicacci are appointed assistant industrial equipment engineers to assist Mr. Weckstein.

Westinghouse Engineering Executives Promoted

Slightly more than a year after he was awarded the Elliot Cresson Gold Medal by the Franklin Institute in recognition of his scientific achievements, Mr. Francis Hodgkinson, for many years chief engineer of the South Philadelphia Works, Westinghouse Electric & Manufacturing Co., was appointed consulting mechanical engineer for the organization as a whole, taking effect immediately.

Simultaneously an order discontinuing the position of chief engineer of the South Philadelphia Works and creating instead the position of manager of engineering was announced. Appointed to the new position is Mr. A. D. Hunt, well known in engineering circles throughout the country and for many years a member of the engineering staffs of the Westinghouse organization.

With the duties and responsibilities of Mr. Hodgkinson broadened according to the new arrangement, his great knowledge, which has earned fame for him both in this country and abroad, will be made available to all of the operations of the company. His prime duty will be to act as consulting engineer in all design problems and other engineering activities at South Philadelphia.

In April, 1925, Mr. Hodgkinson was the recipient of the Elliot Cresson Gold Medal, presented to him particularly in recognition of his important part in the development of the steam turbine, during more than three decades past.

Westinghouse Promotes Seybold

Roscoe Seybold, formerly manager of price statistics of the Westinghouse Electric & Manufacturing Co., has been appointed assistant to F. A. Merrick, vice-president and general manager of the company.

Mr. Seybold has been with the Westinghouse Co. since 1907. He was born in Rockville, Ind., and attended Purdue University. After graduating from that school in 1907, with the degree of bachelor of science in electrical engineering, he immediately came to East Pittsburgh, where he entered the college graduate apprentice course. At its completion he was placed in the price department and later was transferred to the sales department, where he was located for some years prior to this present appointment.

Westinghouse Company Receives Orders For Seven Automatic Substations For Coal Mine Operation

The Westinghouse Electric & Manufacturing Co., has recently received orders for control equipment for seven automatic substations to be used for

the operation of coal mines. Two of these sets have been sold to the Lehigh Valley Coal Co., and one each to the Harlem Collieries Co., the West End Coal Co., the Youghiogheny & Ohio Coal Co., the Vesta Coal Co., and the West Kentucky Coal Co. The Youghiogheny & Ohio Coal Co., have also ordered automatic control for an air shaft substation.

Osgood Company Purchases Fairbanks Assets

The Osgood Co., has purchased from the receiver of The Fairbanks Steam Shovel Co., at Marion, Ohio, the good will and all the assets of the Fairbanks Steam Shovel Co., such as patterns, records, drawings, formers, etc., together with the entire stock of material that was on hand for the manufacture of steam and gas shovels and dredges.

The purchasers are prepared to furnish from the records and drawings now in their possession repair parts for Fairbanks machinery and equipment that is now in the field.

Mr. Chas. Melvin who was connected with the Fairbanks Steam Shovel Co., for 24 years has been retained by the Osgood Co., and placed in charge of the department for handling service and repair parts on Fairbanks machines.

Alloy Cast Steel Company Organized

The Alloy Cast Steel Co., Marion, Ohio, has recently been organized by John D. Owens, C. A. Owens, M. C. McNeil, H. J. Barnhart, Frank D. Glosser, Walter A. Dorsey, and E. J. Schoenlaub, all of Marion, Ohio.

The company has purchased the electric steel foundry of the Fairbanks Steam Shovel Co. which was recently sold at receiver's sale. The plant is now being completely overhauled and enlarged to a capacity of 400 tons of steel castings per month. Extensive additions of modern foundry equipment will be installed at once.

The new company will manufacture high-grade electric steel castings in carbon, manganese, and other alloy steel.

The new owners have had considerable past experience in the manufacture of steel castings and have already perfected an operating organization capable of making high-grade steel castings and giving prompt and satisfactory service.

Appointment of General Electric Assistant Treasurers

Announcement has been made by R. S. Murray, treasurer of the General Electric Co., of the election of Delbert C. Davis and Charles L. Kenyon as assistant treasurers of the company. Both are residents of Schenectady, N. Y.

Mr. Davis was formerly with the Fort Wayne Electric Works as assistant treasurer in charge of credits and collections. He went to Schenectady in June, 1909, as general credit manager.

Mr. Kenyon became connected with the collection department of the General Electric Co. in March, 1924, and has been assistant to Mr. Murray for several years in that department.

Sullivan Moves Spokane Office to Larger Quarters

The Sullivan Machinery Co., announces that, effective June 1, its northwestern sales office at Spokane, Wash., will be situated at 120 South Lincoln St., Spokane, instead of in the Hutton Building as heretofore. The change provides larger quarters and the offices, display room and warehouse will be together at this new location.

American Abrasive Metals Co., have issued a leaflet describing and illustrating new forms of safety tread as used extensively in power plants, which they will send to those desiring information on this subject upon request to their New York office, 50 Church St.

A new coal machinery catalog has just been released by the Sullivan Machinery Co., which deals with a new type of Longwall Coal Mining Machine, which is of particular interest as it is a completely redesigned machine and while retaining the same power and cutting ability as the older standard machine, is very much more compact and is only 12 inches in height as compared with the previous machine which was 18 inches high. This machine is described in Bulletin 82-B. The new machines have been in successful use in Great Britain for about 2½ years and have demonstrated their qualities of increased cutting capacity, stability and repair economy in the difficult field.

Another new bulletin describes their new Shearing Machine, Catalog No. 82-C. This is a new machine which has not as yet been described in the engineering press.

A new catalog has just been issued by the Mueller Steam Specialty Co., 502 West 126th St., New York City, describing their modern steam, water, air, oil and gas specialties, consisting of Pressure Reducing and Regulating Valves, Strainers, Boiler Controls, Steam Traps, Back Pressure and Vacuum Regulators, Excess Pressure Relief Valves, Float Valves, Quick Opening Balance Valves, Pump Governors, Air Traps, Liquid Level Controllers, etc.

New Handbook for Wire Rope Users

How to measure wire rope; how to and how not to uncoil or unreel wire rope; how to make an endless splice; how to properly seize rope; how to correctly socket wire rope; how to care for wire rope when both in and out of service, are just a few of the things told in the new 88-page handbook on wire rope recently issued by the American Cable Co., New York.

In addition to such information, there is shown by detailed drawings the best methods for making equalizing slings, bridle slings, and other miscellaneous sling and fitting equipment. There also appear briefened, though complete, treatises on wire rope lubrication, the effect of heat on wire rope performance, alignment, reverse bends, fleetangle, idle ropes, and other such subjects. Seldom have we seen a book that covers in a more informative way every phase of wire rope usage, application, and maintenance. Not only does it give detailed information regarding the various "lays" and the varying constructions of wire rope but much data that should prove invaluable to wire rope users.

A copy of this handbook is to be had by addressing the publishers of this magazine.

New Bulletins recently issued by the Sullivan Machinery Co., include:

Bulletin 81-L, Rock Drill Tunnel Carriages.

Bulletin 76-G, Portable Single and Double Drum Electric Hoists.

Bulletin 83-B, Second Edition, Single and Two-stage Straight Line Air Compressors for belt drive.

The Drill Carriage described in Bulletin 81-L is one of their own inventions, having been developed first in its present state by Mr. D. J. O'Rourke, a rock drill engineer of many years experience, when he was in charge of one of the portals of the Moffatt Tunnel, in Colorado some two years ago. The carriages are in successful use on the Great Northern Tunnel at Scenic, Wash., (A. Guthrie & Co., St. Paul, Contractors), on the Nevada Irrigation Project Tunnel near Immigrant Gap, Calif. (D. A. Foley & Co., Contractors), and elsewhere.

The Alexander Milburn Co., 1416 West Baltimore St., Baltimore, Md., has issued a new catalog dealing with Milburn Welding and Cutting Apparatus. Copies may be obtained upon request to their Baltimore office.

"Bethlehem Steel Ties for Mines and Industrial Track" is the title of the new bulletin just released by the Bethlehem Steel Co., Bethlehem, Pa. It is fully illustrated, and carries a vast amount of information on Bethlehem equipment.

ADMIRALTY
New River Smokeless

Admiralty Coal
New River Smokeless

Prepared over Shaker Screens and Loading Booms
Highest Standards of Preparation
LUMP EGG NUT

DEPENDABLE COAL
Anthracite

GENERAL COAL COMPANY
PHILADELPHIA

BOSTON CHARLESTON CHARLOTTE CINCINNATI
DETROIT NEW YORK NORFOLK PITTSBURGH

BUNKER COAL
SUPPLIED AT
BALTIMORE, MD.
CHARLESTON, S. C.
HAMPTON ROADS, VA.
JACKSONVILLE, FLA.
NEW YORK
PHILADELPHIA
SAVANNAH, GA.

EXPORT AND COASTWISE COAL
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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

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Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

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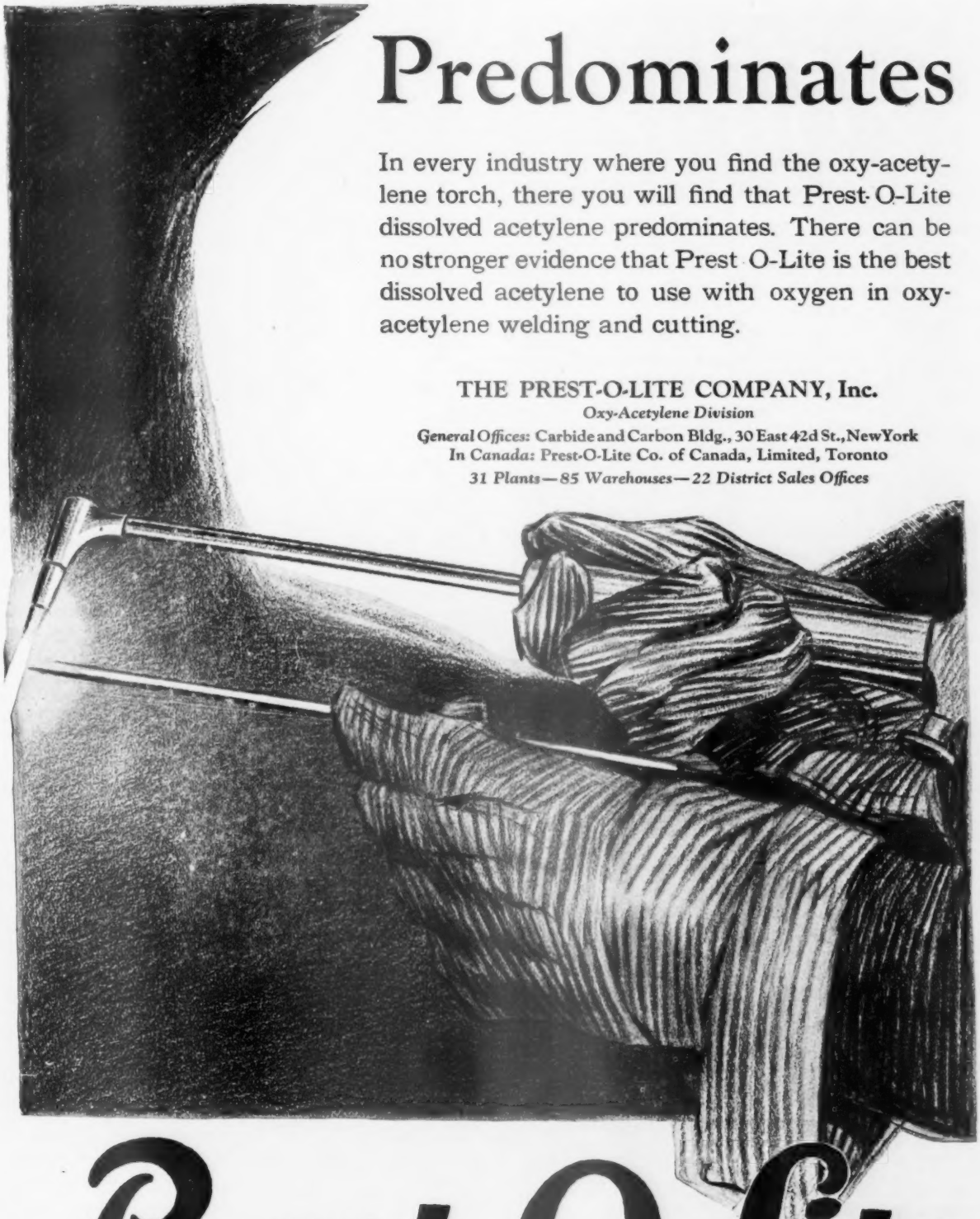

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DISSOLVED ACETYLENE

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CONVEYORS, SCREW
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Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

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DECARBONIZING APPARATUS
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DRILLS, PNEUMATIC
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General Electric Co., Schenectady, N. Y.

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Ohio Brass Co., Mansfield, Ohio.

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Central Frog & Switch Co., Cincinnati, Ohio.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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GAS (Nitrogen, Oxygen)
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Oxweld Acetylene Co., 30 E. 42nd St., New York City.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

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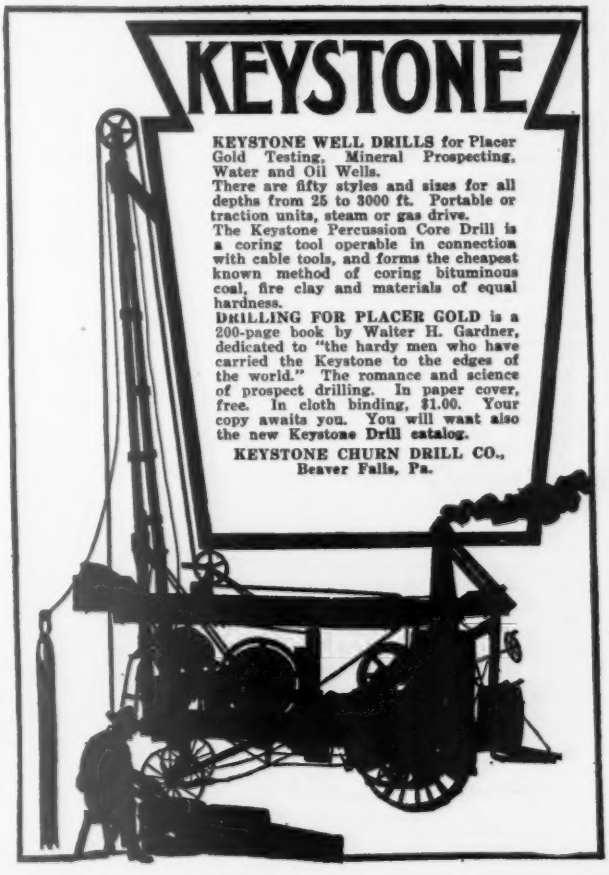

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Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

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Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

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GEARS, WORM
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Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
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GEARS, WORM WHEELS
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Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

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GLOVES, ASBESTOS
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GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

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Ohio Brass Co., Mansfield, Ohio.
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Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

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Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, ELECTRIC
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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

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Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

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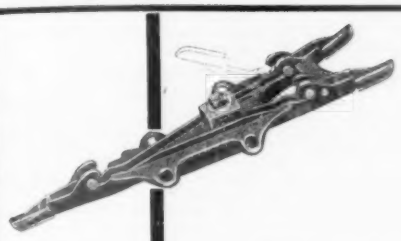

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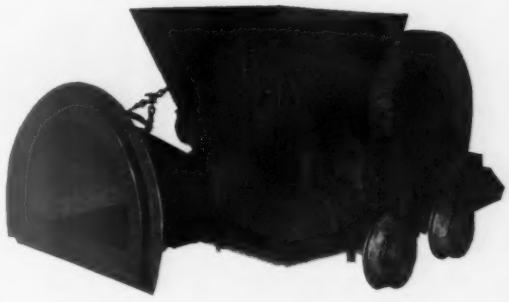

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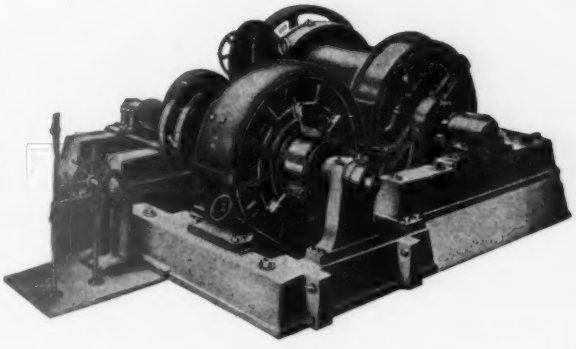

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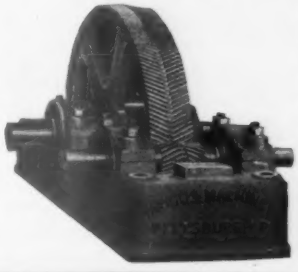

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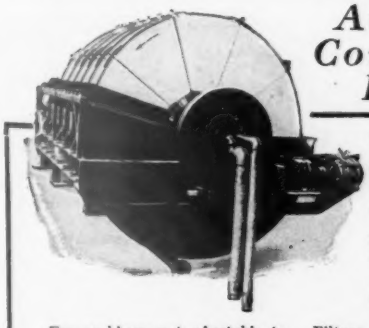

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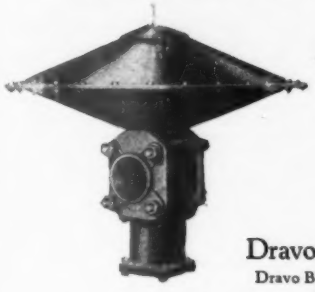

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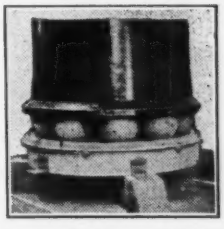

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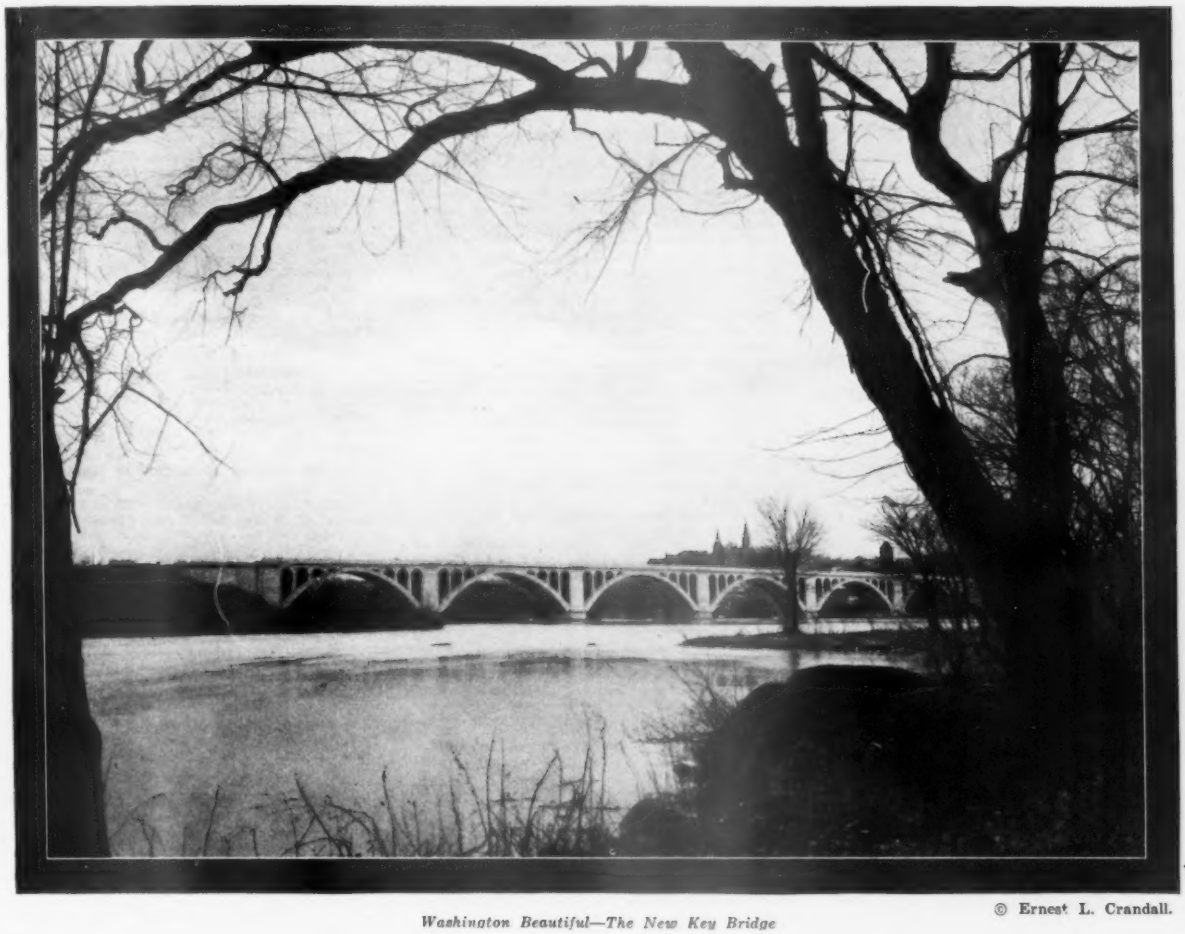

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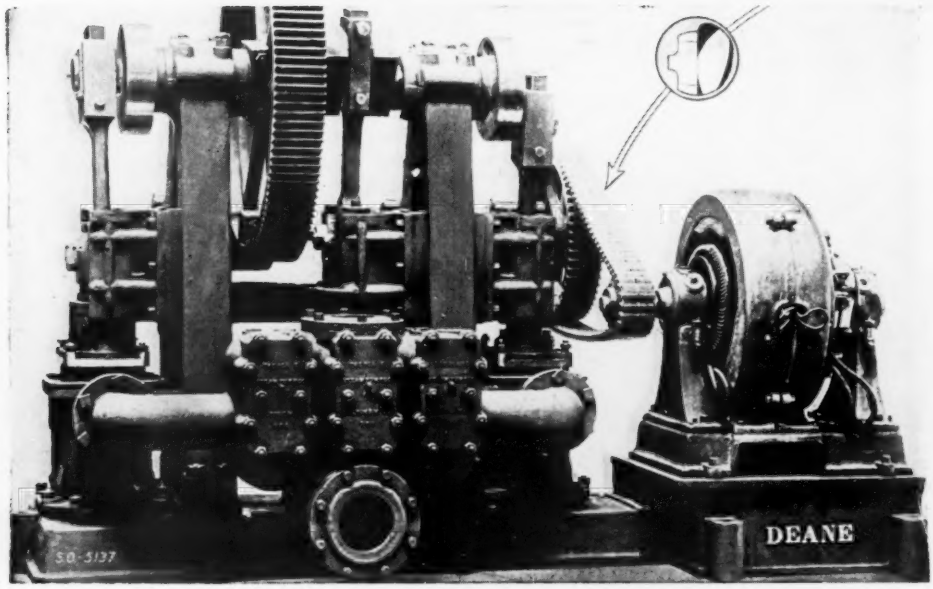

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